MACHINERY
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WIRING ON MOTOR-DRIVEN MACHINERY

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ELECTRICAL wiring on the motor-driven machines furnished by even the best manufacturers, is too often poorly arranged and inefficiently installed. This is because the wiring is not considered when the machine is designed. Its installation is usually left to some workman who does the best he can. The wiring and arrangement of the control apparatus should be laid out in the drafting-room. This article discusses the best methods of machine wiring, describes the materials used, and gives concrete directions, rules and tables for wiring motor-driven machinery.

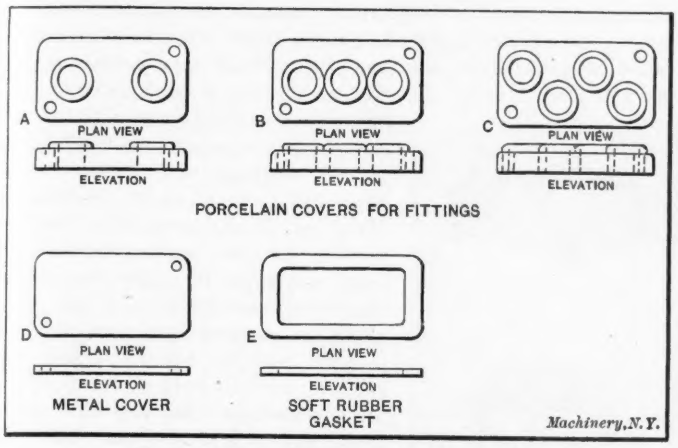


Fig. 1. Covers and Gasket for Conduit Fittings

TABLE I. SPECIFICATIONS FOR WIRE AND CONDUIT ON MOTOR-DRIVEN MACHINERY

Double-braid, Rubber-covered, 0 to 600 Volts, N. E. C. S. Copper Wire, N. E. C. S. Wrought-iron Conduit

	Number of Wire, B. & S. Gage	Area of Wire, Circular Mills	Number of Wires in Strand	Safe Current-carrying Capacity, Amperes	Size of Conduit, Inches		
					1 Wire in Conduit	2 Wires in Conduit	3 Wires in Conduit
Solid Wire	18	1,624	Solid	3	½	½	½
	16	2,583		6	½	½	½
	14	4,107		12	½	½	¾
	12	6,530		17	½	¾	¾
	10	10,380		24	½	¾	1
	8	16,510		33	½	1	1
Stranded Wire	6	26,250	7	46	¾	1	1¼
	5	33,100	7	54	¾	1¼	1¼
	4	41,740	7	65	¾	1¼	1½
	3	52,630	7	76	¾	1¼	1½
	2	66,370	19	90	¾	1½	2
	1	83,690	19	107	1	1½	2
	0	105,500	19	127	1	2	2
	00	133,100	19	150	1	2	2
	000	167,800	19	177	1¼	2	2½
	0000	211,600	19	210	1¼	2	2½
	....	200,000	19	200	1¼	2	2½
	....	250,000	37	235	1½	2½	2½
	....	300,000	37	270	1½	2½	3
	....	350,000	37	300	1½	2½	3
	....	400,000	37	330	1½	3	3
	....	450,000	37	380	2	3	3½
	....	500,000	61	390	2	3	3½
	....	550,000	61	420	2	3½	4
	....	600,000	61	450	2	3½	4
	....	650,000	61	475	2	3½	4
	....	700,000	61	500	2	3½	4

One industrial corporation which purchases many motor-driven machines incorporates the following clauses in the specifications for all such equipments:

1. The machine manufacturer shall mount the motor and controlling devices on the machine so that they shall form a part thereof, and shall wire between them as hereinafter noted.

2. The controlling apparatus shall be conveniently arranged for manipulation by the machine operator.

TABLE II. APPROXIMATE FULL-LOAD CURRENT (IN AMPERES) TAKEN BY ELECTRIC MOTORS

H.P. of Motor	Direct-current Motors			Alternating-current Motors								
				Single-phase			Two-phase (Four-wire)			Three-phase (Three-wire)		
	110 Volts	220 Volts	500 Volts	110 Volts	220 Volts	500 Volts	110 Volts	220 Volts	500 Volts	110 Volts	220 Volts	500 Volts
1	9	5	2	14	8	3	6	3	2	7	4	2
2	16	9	4	25	13	5	12	6	3	13	7	3
3	27	13	6	34	17	8	17	8	4	19	9	4
5	42	21	9	53	26	12	25	13	6	31	15	6
7½	60	31	13	75	38	16	39	20	8	45	22	9
10	77	37	18	93	49	22	44	23	11	51	25	13
15	111	57	26	....	....	....	66	34	15	77	39	17
20	151	76	34	....	....	....	89	44	20	103	52	23
30	226	114	49	....	....	....	135	68	30	155	78	33
40	303	152	67	....	....	....	179	90	39	205	107	46
50	369	183	83	....	....	....	205	102	44	237	119	52
75	551	277	123	....	....	....	310	155	69	356	179	78
100	737	369	162	....	....	....	409	206	91	473	236	105
150	1114	556	245	....	....	....	618	308	137	711	356	157
200	1475	736	326	....	....	....	820	410	183	940	472	210

3. All wiring shall be installed in accordance with the regulations of the National Electrical Code.

4. All wiring shall be carried in wrought-iron conduit or in metal conduit fittings. These shall be firmly attached to the frame of the machine.

5. So far as possible, all "live" bare metal parts shall be enclosed with metal covers.

It was found desirable to make these requirements because of the awkward practice prevailing in this respect among machine builders. Frequently, the builder of a motor-driven machine, although he carefully mounted the motor and arranged the drive between the machine and the motor, would fail to mount the motor-starter or controller on the machine. If he did mount it on the machine, in the great majority of cases he would either provide no wiring between the motor and the controller, or install the wiring in such a careless, unbusinesslike manner that it would have to be reinstalled. Usually, the machine builder makes an extra charge for ar-

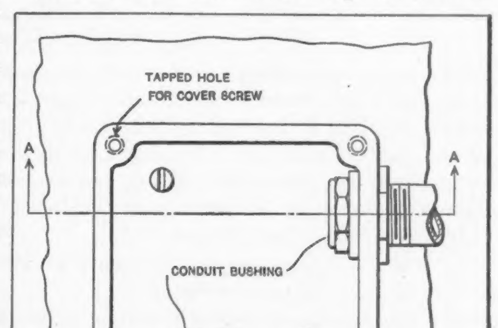


Fig. 2. Outlet Box Mounted on Machine

ranging the wiring in accordance with the above specifications; but it was found that the work was done better and more cheaply by the builder than by the wire-men at the plants where the machines were installed. At the present time, when motor-driven machinery is so generally used, machine builders are paying more attention to the electrical details; but there is still much to be desired. In the following will be given some practical information that may be of value to manufacturers desiring to arrange and install the wiring on their machines as efficiently as possible. It is believed that good wiring will be appreciated by the purchaser.

Rule No. 1 in the specifications given states that when the machine is direct-driven the motor and controller should be considered as a part of the machine. Obviously, they are just as much so as is a gear. If possible, the complete equipment should be shipped so that, after setting up, it will only be necessary for the plant electrician to run a pair of wires to put the machine in service. For large machines, which must be dismantled for transportation, the motor and controlling equipment must be shipped separately, and it may be necessary to dismount the conduit carrying the electrical conductors; but if the wiring has been properly connected and the conduit strapped to the machine in the erecting shop, it can easily be reinstalled. Thus, cranes, which have complicated wiring, can be taken apart, shipped, re-erected and rewired with very little difficulty.

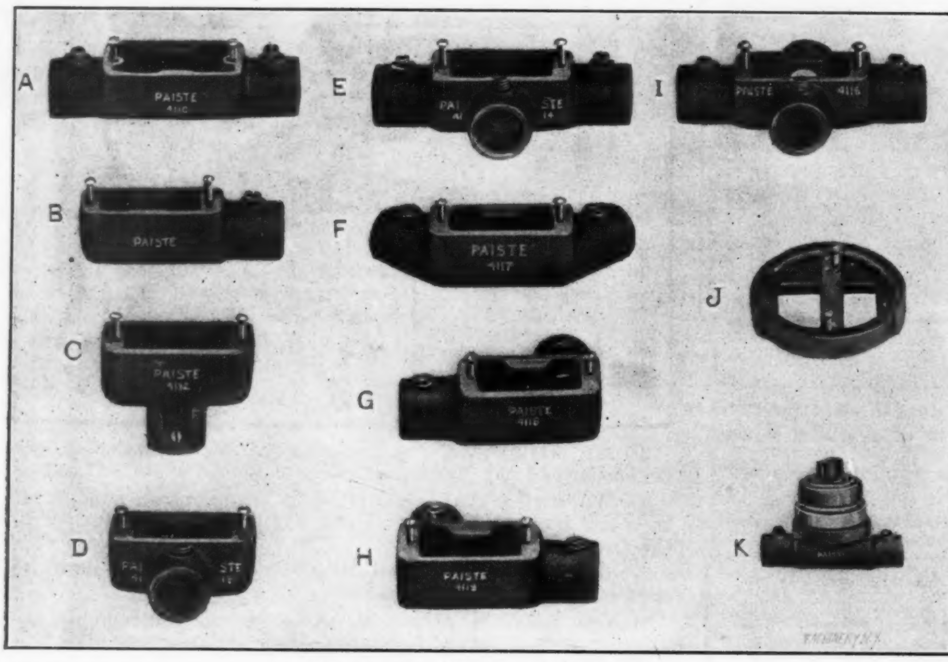


Fig. 3. Types of Cast-iron Conduit Fittings

The desirability of the requirements of Rule No. 2 is so obvious as to need no discussion.

Rule No. 3 requires that all wiring be installed in accordance with National Electrical Code regulations. Standard fire insurance policies require that the electrical work in all plants having insurance protection be installed in accordance with these regulations. It has taken many years to mold the regulations into their present excellent form, and they are revised constantly to keep abreast with the advances in the art. It is therefore essential that machines which are to be installed in plants carrying fire insurance, be wired in accordance with the Code. Even if insurance is not carried, it is advisable to follow these rules, as they outline a substantial and safe method of wiring. A copy of The National Electrical Code will be supplied free to anyone making request to the local Fire Underwriters' Inspection Bureau or to the Underwriters' Laboratories, Chicago, Ill.

Rule No. 4 requires that wiring be installed in wrought-iron conduits or in metal conduit fittings. It costs several times as much to run wiring in metal conduit (the properties of conduit are given in Table III) as to arrange it without mechanical protection. However, it is only the first cost of conduit wiring that is high. When placed in conduit the wiring is done once for all; there is no future trouble from broken wires, grounds or short circuits, due to abraded insulation. When arranged with conduit wiring, the machine is easier to keep clean and looks neater. The conduit fittings (which will be described later) are used at points where wires issue from the conduit or where a turn in the conduit run is necessary and it is not desired to bend the conduit. In general construction, they somewhat resemble screwed pipe fittings, but they are always arranged with removable covers so that the wire is easily accessible. Conduit and fittings are attached to machine frames with either pipe straps (Table VI) or machine screws, as will be described.

Rule No. 5 requires that all "live" bare metal parts be enclosed within metal covers. It is usually feasible to enclose these parts. Such enclosure prevents metallic chips from forming grounds or short circuits and renders shock to attendants impossible. With the voltages at which machine motors are usually operated, a shock is not often fatal, but one hears of cases where men have been killed from contact with 220-volt circuits. At any rate, an electrical shock is unpleasant, and if there is a possibility of receiving one the attendant is likely to be cautious and waste time. Fire risk is reduced by enclosing "live" parts. Although the Underwriters do not require enclosure they commend it. The electrical manufacturers appreciate the demand for enclosed apparatus, and it is now possible to buy standard starters and controllers, for nearly all applications, that are well protected and so arranged that conduit wiring can be readily installed.

Wire for Motor Application

The size of wire to use for transmitting electrical energy (in low-voltage work such as that involved in industrial-plant wiring) is determined by two requirements, *viz.*, the cross-sectional area must be large enough to carry the current required without getting too hot, but must not be so large as to cause an excessive drop in voltage—electrical pressure—and consequent energy loss. However, the distances involved in wiring machinery are so short that the latter requirement may be disregarded altogether. The only demand is, then, that the wire be big enough to obviate excessive heating.

The National Electrical Code specifies that all concealed wires shall be rubber-insulated and, in addition, that all wires carried in conduit shall have a double-braid covering. All standard rubber-covered wires used for voltages above 10 and below 600 have the same thickness of insulation. Copper wire is almost universally used for interior wiring. Therefore, if the voltage of the motor is below 600, wire for the installation should be specified, for example, thus: No. 6 National Electrical Code Standard, 0-600 volts, double-braid, stranded, copper wire. The size of wire, and whether it is to be solid or stranded is determined, as will be explained, by the horsepower output of the motor.

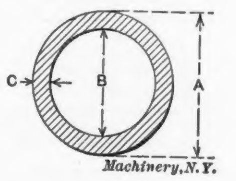
So that wire in service will not be dangerously overheated, the Underwriters have specified a certain safe current-carrying capacity for each size of wire and for wires having different insulating materials. In Table I are given the safe current-carrying capacities for all sizes of rubber-covered wire that the machine builder is likely to use. The sizes listed are all commercial ones and are, as a rule, readily obtainable. When the current or amperes taken by any motor is known, the size of wire to be used can be ascertained from Table I. Although Nos. 18 and 16 wires are listed in the table, the Underwriters do not permit the use, for applications such as herein treated, of any wire smaller than No. 14. It will be noted that the wires between No. 18 and No. 8 inclusive are tabulated as

"solid" and those larger than No. 8, as "stranded." Solid wire is that having a solid conductor, while the conductor in stranded wires is twisted up from several or many wires of relatively small diameter. Stranded wires are sometimes called cables. It is the usual practice in conduit work to specify that wires larger than No. 8 be stranded because, if solid, they are too stiff to be handled and pulled into the conduit readily. Solid wires can be obtained, if desired, in sizes much larger than No. 8 and these are much used in "open-work" wiring. The numbers of wires in a strand given represent the practice of some manufacturers, but other manufacturers have different standards. They vary little, however, from those shown. As a rule it is not desirable to specify the "number of wires in strand" when ordering, as the dealer may not be able to furnish just the stranding designated, from his stock. Any stranded wire, for conduit work, will answer the purpose, and the use of stock sizes will obviate delay.

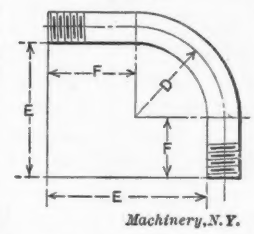
The size of wire to use for machine wiring is determined by the current (amperes) only. The current taken by any motor may readily be computed from rules given in electrical handbooks. If the motor is available, its exact full-load current is, in accordance with a Code rule, stamped on its name-plate. If the motor is not available, a full-load current value, accurate enough for the present need, can be taken from Table II. It should be understood that the tabulated values are averages and may vary somewhat from name-plate ratings. Different makes of motors of the same horsepower, have different efficiencies and, with alternating-current motors, different power factors, and both these appreciably affect the amount of current taken. The figures given in Table II indicate the current in each wire. That is, they show the number of am-

TABLE III. PROPERTIES OF CONDUIT, ELBOWS AND COUPLINGS

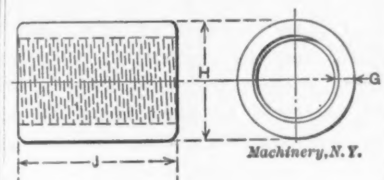
CONDUIT



ELBOWS



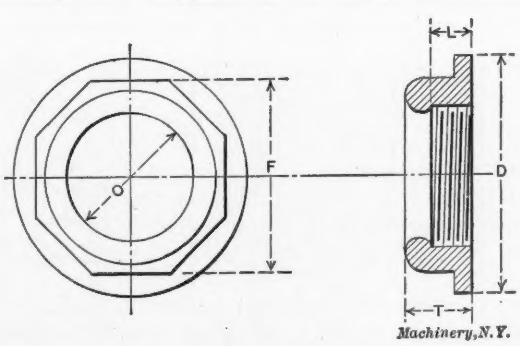
COUPLINGS



Nominal Size of Conduit	A Outside Diameter		B Inside Diameter		C Thickness of Walls		Nominal Weight, Pounds per Foot	D Radius of Center Line	E Offset	F Length of Str'ght Portion	Weight of 100 in Pounds	G Thick-ness	H Outside Dia-meter	J Length	Weight of 100 in Pounds
	Actual	Fraction to Nearest 64th	Actual	Fraction to Nearest 64th	Actual	Fraction to Nearest 64th									
$\frac{1}{2}$	0.84	$\frac{27}{32}$	0.623	$\frac{5}{8}$	0.109	$\frac{3}{32}$	0.85	$4\frac{1}{2}$	$7\frac{1}{2}$	$2\frac{9}{16}$	73	$\frac{1}{4}$	$1\frac{3}{32}$	$1\frac{5}{16}$	$15\frac{1}{2}$
$\frac{3}{4}$	1.05	$1\frac{1}{16}$	0.824	$\frac{53}{64}$	0.113	$\frac{7}{64}$	1.12	$5\frac{3}{8}$	$9\frac{1}{4}$	$3\frac{1}{4}$	132	$\frac{19}{64}$	$1\frac{11}{32}$	$1\frac{9}{16}$	$25\frac{1}{2}$
1	1.315	$1\frac{21}{64}$	1.048	$1\frac{3}{64}$	0.134	$\frac{1}{8}$	1.67	$5\frac{3}{4}$	$10\frac{1}{8}$	$4\frac{5}{8}$	200	$\frac{11}{32}$	$1\frac{21}{32}$	$1\frac{3}{4}$	$40\frac{1}{2}$
$1\frac{1}{4}$	1.66	$1\frac{21}{32}$	1.380	$1\frac{3}{8}$	0.140	$\frac{9}{64}$	2.24	$7\frac{1}{4}$	$11\frac{1}{2}$	$3\frac{7}{16}$	300	$\frac{11}{32}$	2	$1\frac{15}{16}$	$57\frac{1}{2}$
$1\frac{1}{2}$	1.90	$1\frac{29}{32}$	1.611	$1\frac{39}{64}$	0.145	$\frac{9}{64}$	2.68	$8\frac{1}{2}$	$12\frac{5}{8}$	$3\frac{3}{16}$	415	$\frac{3}{8}$	$2\frac{9}{32}$	$2\frac{3}{16}$	$71\frac{1}{4}$
2	2.375	$2\frac{3}{8}$	2.067	$2\frac{1}{16}$	0.154	$\frac{5}{32}$	3.61	$9\frac{1}{2}$	$15\frac{1}{4}$	$4\frac{9}{16}$	700	$1\frac{1}{32}$	$2\frac{13}{16}$	$2\frac{5}{16}$	132
$2\frac{1}{2}$	2.875	$2\frac{7}{8}$	2.468	$2\frac{15}{32}$	0.204	$\frac{13}{64}$	5.94	$10\frac{1}{2}$	$17\frac{3}{4}$	$5\frac{13}{16}$	1138	$\frac{17}{32}$	$3\frac{9}{32}$	$2\frac{11}{16}$	185
3	3.50	$3\frac{1}{2}$	3.067	$3\frac{1}{16}$	0.217	$\frac{7}{32}$	7.54	13	$19\frac{3}{8}$	$4\frac{5}{8}$	1885	$\frac{33}{64}$	$4\frac{1}{64}$	3	300
$3\frac{1}{2}$	4.00	4	3.548	$3\frac{35}{64}$	0.226	$\frac{7}{32}$	9.00	15	21	4	2100	$\frac{1}{2}$	$4\frac{1}{2}$	$3\frac{1}{8}$	400
4	4.50	$4\frac{1}{2}$	4.026	$4\frac{1}{32}$	0.237	$\frac{15}{64}$	10.66	16	$32\frac{1}{2}$	$4\frac{1}{2}$	2160	$\frac{1}{2}$	$5\frac{3}{32}$	$3\frac{1}{8}$	412

All dimensions in inches. All tubes are 10 feet long, threaded at both ends and furnished with a coupling. These dimensions were taken from manufacturers' tables and from samples.

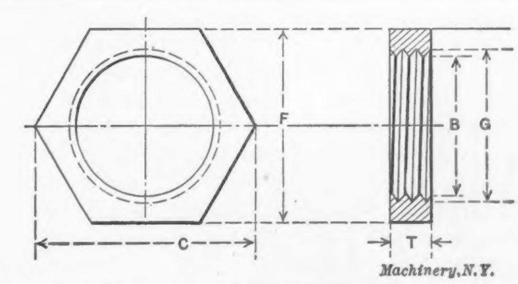
TABLE IV. DIMENSIONS OF CONDUIT BUSHINGS



Thomas and Betts Bushings. All Dimensions taken from Samples. All Dimensions in Inches

Size of Conduit	F	D	O	T	L
$\frac{3}{8}$	$\frac{25}{32}$	$\frac{27}{32}$	$\frac{15}{32}$	$\frac{11}{32}$	$\frac{3}{16}$
$\frac{1}{2}$	$\frac{15}{16}$	$1\frac{1}{32}$	$\frac{19}{32}$	$\frac{13}{32}$	$\frac{1}{4}$
$\frac{3}{4}$	$1\frac{5}{32}$	$1\frac{1}{4}$	$\frac{3}{4}$	$\frac{15}{32}$	$\frac{1}{4}$
1	$1\frac{13}{32}$	$1\frac{17}{32}$	$\frac{31}{32}$	$\frac{17}{32}$	$\frac{5}{16}$
$1\frac{1}{4}$	$1\frac{11}{16}$	$1\frac{29}{32}$	$1\frac{5}{16}$	$\frac{19}{32}$	$\frac{3}{8}$
$1\frac{1}{2}$	$1\frac{31}{32}$	$2\frac{5}{32}$	$1\frac{17}{32}$	$\frac{5}{8}$	$\frac{13}{32}$
2	$2\frac{15}{32}$	$2\frac{11}{16}$	$1\frac{15}{16}$	$\frac{21}{32}$	$\frac{13}{32}$
$2\frac{1}{2}$	$2\frac{7}{8}$	$3\frac{5}{32}$	$2\frac{11}{32}$	$\frac{3}{4}$	$\frac{15}{32}$
3	$3\frac{17}{32}$	$3\frac{25}{32}$	$2\frac{27}{32}$	$\frac{7}{8}$	$\frac{17}{32}$
$3\frac{1}{2}$	$4\frac{1}{8}$	$4\frac{7}{16}$	$3\frac{5}{16}$	1	$\frac{19}{32}$
4	$4\frac{5}{8}$	$5\frac{1}{16}$	$3\frac{13}{16}$	$1\frac{1}{16}$	$\frac{21}{32}$

TABLE V. DIMENSIONS OF CONDUIT LOCK-NUTS



Thomas and Betts Lock-nuts. All Dimensions taken from Samples. All Dimensions in Inches

Size of Conduit	Threads per Inch	B	G	F	C	T
$\frac{3}{8}$	18	0.568	0.658	1	$1\frac{1}{8}$	$\frac{3}{16}$
$\frac{1}{2}$	14	0.701	0.815	$1\frac{1}{16}$	$1\frac{7}{32}$	$\frac{5}{32}$
$\frac{3}{4}$	14	0.911	1.025	$1\frac{1}{4}$	$1\frac{7}{16}$	$\frac{5}{32}$
1	$11\frac{1}{2}$	1.144	1.283	$1\frac{1}{2}$	$1\frac{23}{32}$	$\frac{3}{16}$
$1\frac{1}{4}$	$11\frac{1}{2}$	1.488	1.627	$2\frac{1}{32}$	$2\frac{5}{16}$	$\frac{3}{16}$
$1\frac{1}{2}$	$11\frac{1}{2}$	1.727	1.866	$2\frac{1}{4}$	$2\frac{9}{16}$	$\frac{3}{16}$
2	$11\frac{1}{2}$	2.223	2.339	$2\frac{23}{32}$	$3\frac{1}{8}$	$\frac{7}{32}$
$2\frac{1}{2}$	8	2.620	2.820	$3\frac{1}{4}$	$3\frac{3}{4}$	$\frac{1}{4}$
3*	8	3.241	3.441	$4\frac{11}{32}$	$4\frac{11}{16}$	$\frac{11}{32}$
$3\frac{1}{2}$	8	3.738	3.938	$4\frac{3}{4}$	$5\frac{1}{16}$	$\frac{3}{8}$
4	8	4.234	4.434	$5\frac{1}{2}$	$5\frac{7}{8}$	$\frac{5}{16}$

* This size is octagonal.

peres flowing through each of the two wires to a direct-current or to a single-phase alternating-current motor, through each of the four wires to a two-phase alternating-current motor or through each of the three wires to a three-phase alternating-current motor.

Having found the current, in amperes, taken by a motor, the size of wire to be used can not be selected without first considering another point. National Electrical Code, Rule 8b, reads, in part, as follows: "The motor leads or branch circuits must be designed to carry a current at least 25 per cent greater than that for which the motor is rated. Where wires under this rule would be over-fused in order to provide for the starting current, as in the case of many alternating-current motors, the wires must be of such size as to be properly protected by these larger fuses." The machine builder has no means of knowing what size fuses the purchaser of his

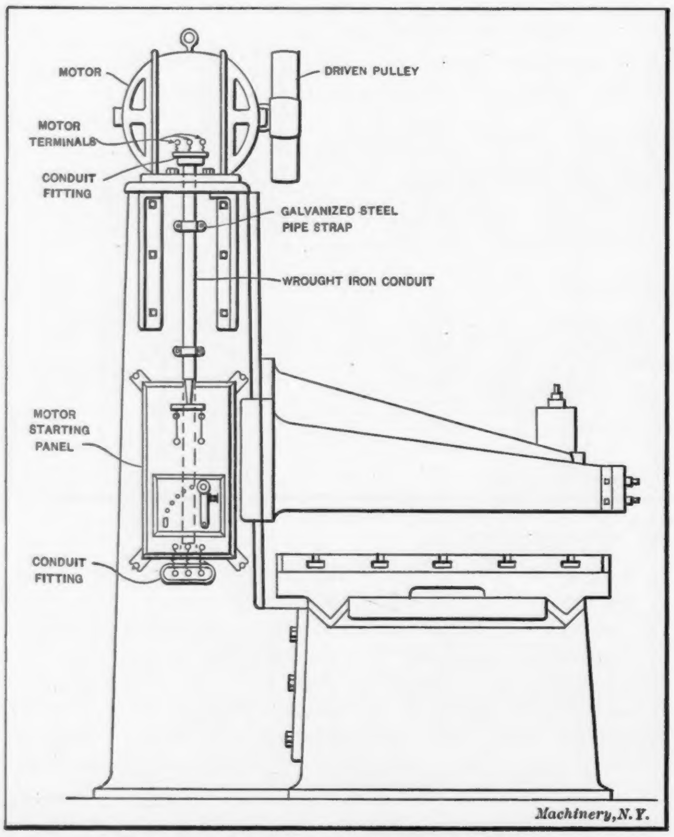


Fig. 4. Open-side Planer with Well-arranged Wiring

appliance will use so that the best thing he can do, ordinarily, is to provide wires capable of safely carrying 25 per cent more current than the full-load rating of the motor in question. The wire size is, then, selected on this basis.

For example, assume that a 10-H. P., 220-volt, three-phase motor is to be wired. Referring to Table II, we find that this motor takes about 25 amperes when operating at full load. To allow for a 25 per cent excess current, in accordance with

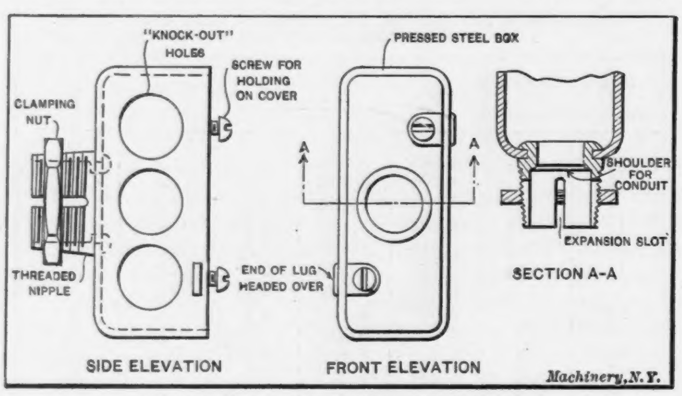


Fig. 5. Details of Typical Pressed-steel Fitting

the Code rule, an estimate is made thus: $25 \times 1.25 = 31$ amperes (about). Referring to Table I, a No. 8 (solid) wire which has a safe carrying capacity of 33 amperes is the smallest that can be used.

The insulation on rubber-covered wire deteriorates very rapidly under the action of heat, so if it is necessary to install conductors where they will be subjected to high temperatures, wire having "slow-burning" insulation should be used. Such wire, if enclosed, must be (according to the Code) in "lined" conduit. This conduit is described under the following heading.

Conduit for Motor Application Wiring

Wrought-iron conduit is merely standard-weight steel, or possibly in some cases wrought-iron pipe, which has been thoroughly cleaned to remove burrs and scale, and then either enameled or coated with zinc. Conduit which meets the requirements of the National Electrical Code and which has been approved by an Underwriters' inspector, is called National electrical Code standard conduit or N. E. C. S. conduit. In Table III are given the principal dimensions of commercial N. E. C. S. conduit, elbows and couplings. Conduit is furnished only in lengths of ten feet. Electrical conduit is threaded with standard pipe threads and standard-weight screwed pipe fittings will fit it.

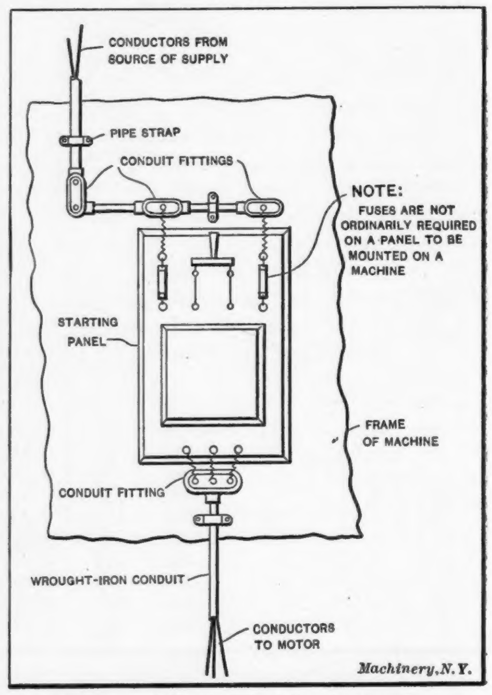


Fig. 6. A Neatly Wired Starting Panel

In addition to the "unlined" conduit, described above, a "lined" conduit is manufactured which has a relatively thick

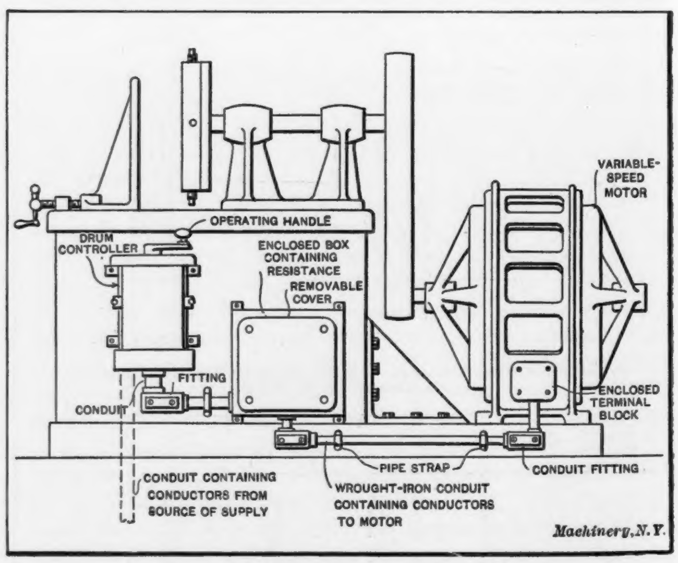


Fig. 7. Machine Equipped with Drum Controller

insulating lining. The lined conduit is seldom used as it is more expensive than the unlined and the latter has given entire satisfaction. The insulating lining appears to be unnecessary, as the rubber insulation on standard wire provides excellent protection.

Although its use would be prohibited by the Underwriters, there is really no objection to using commercial wrought-iron pipe instead of conduit for wiring machines. Such pipe should be carefully cleaned inside and out and every precaution taken to make sure that there are no burrs or slivers on

the inside of the pipe which might cut insulation on wires. After the pipe is painted, it is almost impossible to distinguish it from conduit.

Conduit elbows are formed from conduit to the dimensions indicated in Table III. The smaller sizes of conduit can be

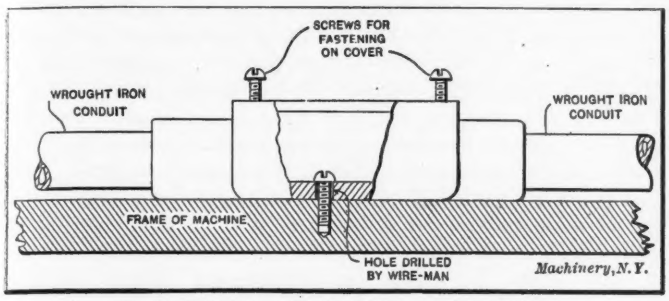


Fig. 8. Satisfactory Method of Supporting Fittings

bent cold to any desired contour, but it requires some skill to do the bending. Conduit-bending machines are obtainable and their installation pays if there is much wiring to be done. Both power- and hand-operated types are manufactured.

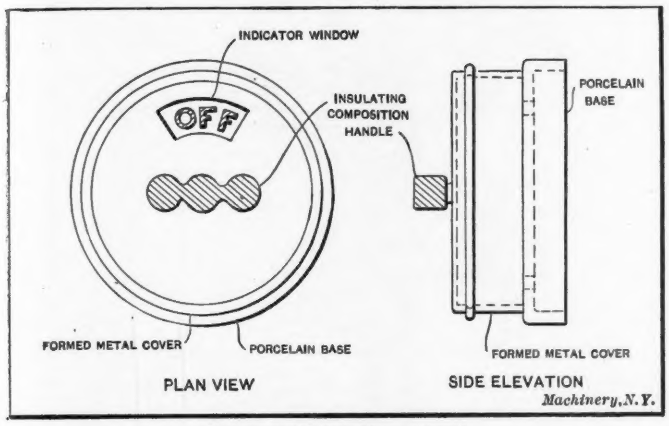


Fig. 9. Indicating Snap Switch

Couplings for conduit are exactly the same as screwed couplings for standard-weight pipe, except that the former are either enameled or coated with zinc, and have a better finish.

After determining the proper size of wire to use for supplying energy to a given motor, the size of conduit to carry it can be selected from Table I. The sizes there tabulated, for the different sizes of wire, have been chosen as the result of much experience with conduit wiring. They are sufficiently large to allow wires to be drawn in or out without the application of excessive force. It is a common error to choose a conduit size so small that the wires must be pulled in with blocks and tackle. If this is done, the insulation is likely to be injured and withdrawal may be impossible.

Conduit Fittings and Sundries

Where wires emerge from conduit ends, the Code requires that provision be made so that a possible burr on the inside of the conduit will not abrade the insulation on the wires when they are being drawn in or out. Conduit ends may be protected either by a bushing, such as shown in the engraving accompanying Table IV, or by a fitting, of one of the types

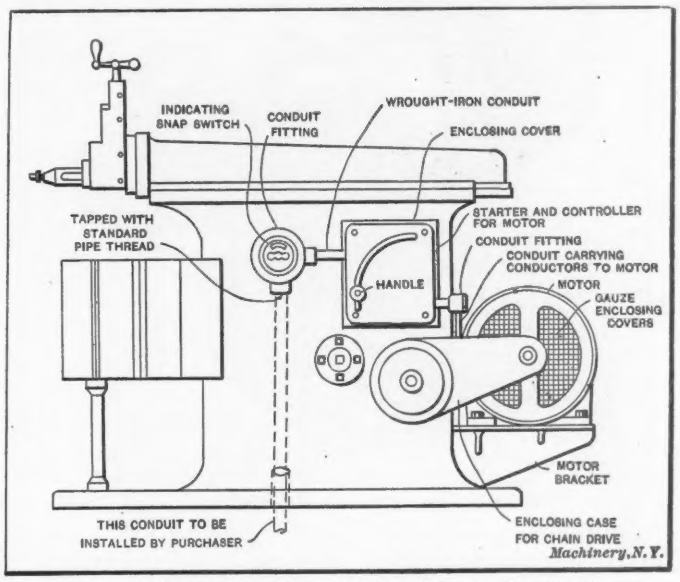


Fig. 11. A Motor-driven Shaper with Completely Enclosed Wiring

shown in Fig. 3, equipped with a porcelain cover, Fig. 1. The bushing should be used when the conduit terminates within an enclosed outlet, junction, or panel box (see Fig. 2) which may be made of either cast or sheet iron. The dimensions given in Table IV will prove useful in indicating what clearances are required for screwing the bushing on the end of the conduit and will also assist in determining the locations for the conduit holes.

Outlet boxes usually have unthreaded holes for the conduit, as indicated in Fig. 2, but where a waterproof installation is essential, the holes should be threaded. When the holes are unthreaded, a lock-nut (shown with Table V) is run on the end of the conduit and, after the bushing is screwed to posi-

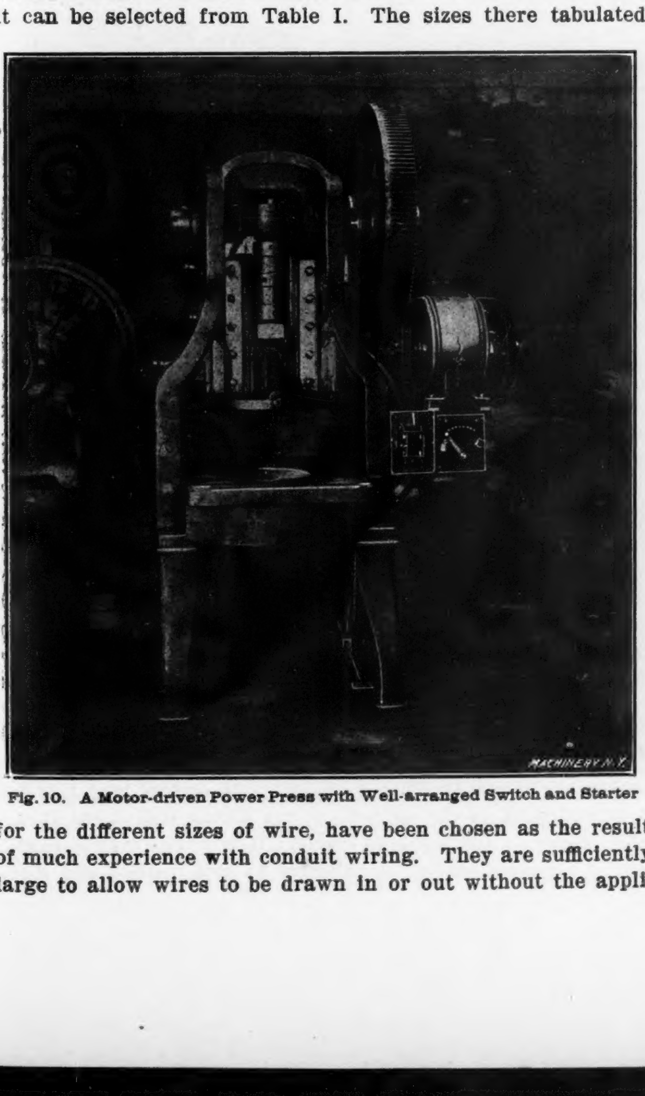


Fig. 10. A Motor-driven Power Press with Well-arranged Switch and Starter

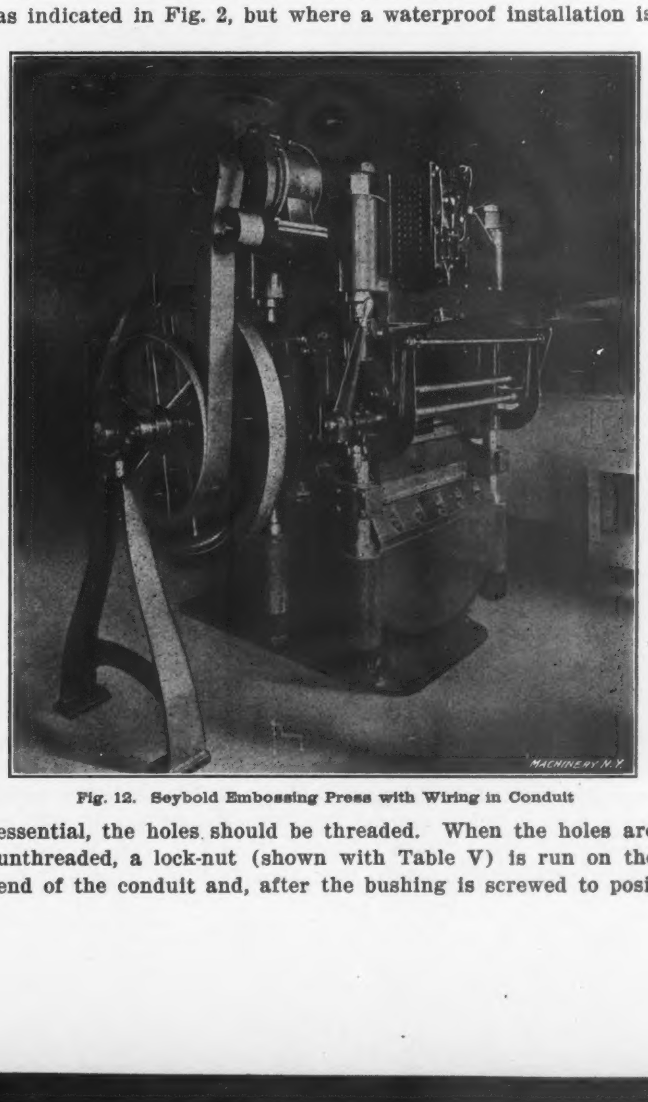


Fig. 12. Seybold Embossing Press with Wiring in Conduit

tion, the lock-nut is turned up snugly against the side of the box, binding the conduit firmly in position. It should be understood that the dimensions given in Tables IV and V for bushings and lock-nuts are accurate for only one manufacturer's line. There are several different makes available, but all will measure approximately the same as those shown.

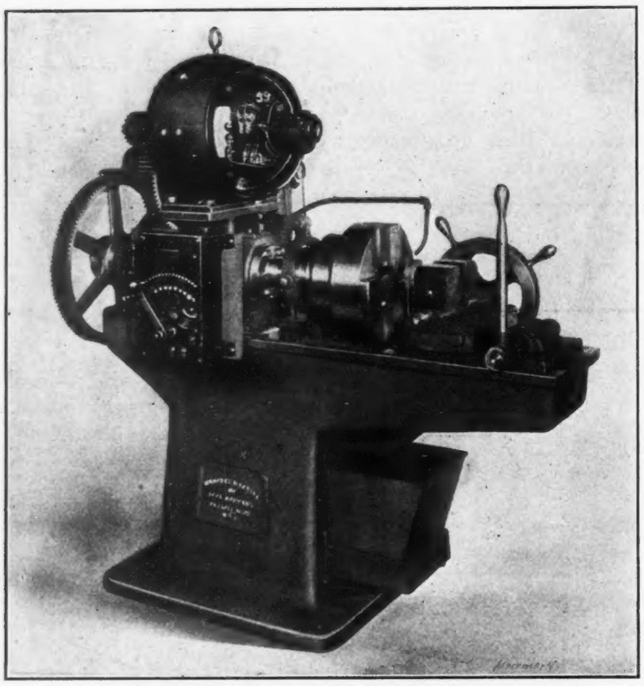


Fig. 13. Motor-driven Pipe Threader with Complete Electrical Equipment

The application of conduit fittings can best be shown by an example. In Fig. 4 is illustrated a motor-driven open-side planer with the wiring between the starter and the motor neatly carried in conduit. At the motor terminal the conductors issue through a fitting which is of the type shown in Fig. 3 at *C* equipped with the cover shown in Fig. 1 at *B*. The conduit fittings are so made that any style of cover of a given pipe size will fit any cast-iron fitting of corresponding pipe size. The covers are held on with brass screws. In Fig. 6 is shown an arrangement of fittings that might be used with the type of starting panel shown in Fig. 4, if the motor were located below instead of above the panel. It will be noted that where "elbow" fittings (*G* and *H*, Fig. 3) are arranged with metal covers, they are effectively used at turns in the conduit run, instead of bends or wrought-iron elbows. Fig. 7 illustrates further applications of conduit-fitting elbows.

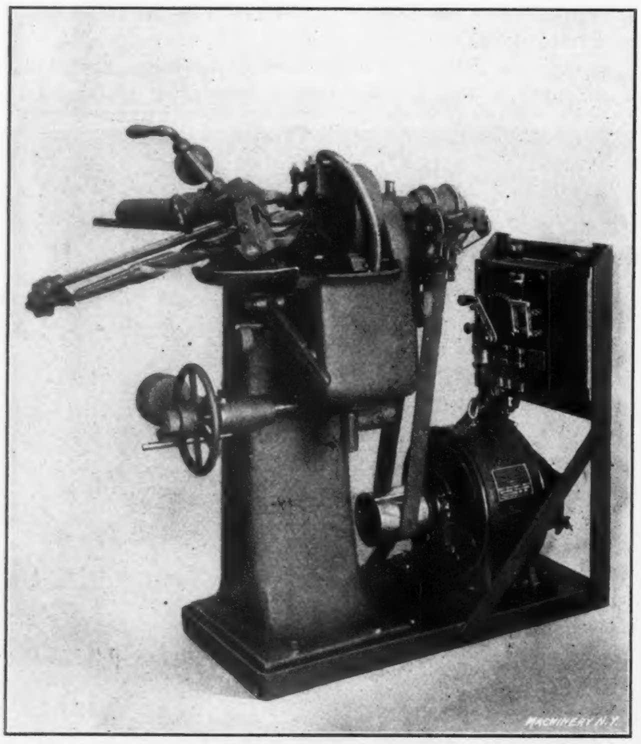


Fig. 14. Drill Grinder with Specially-constructed Support for Starter

A very convenient feature of the fittings shown in Fig. 3 is the provision of a headless set-screw in the throat. By means of this set-screw it is possible to secure a conduit end firmly in a fitting even if the threading on the conduit is faulty or if, because of a bend in the conduit, it does not set up tightly in the fitting, when in its proper position. In this type of fitting, conduit can be secured without being threaded at all. The set-screw provides ample attachment, if conduit and fittings are firmly fastened to a supporting surface, as they usually are on machinery. Nor is it necessary to thread conduit running into fittings like that in Fig. 5. An unthreaded end of a conduit length is inserted in the nipple, the nut is tightened, and the conduit is secured. The threaded portion of the nipple is split and tapered. These fittings possess several advantageous points. Being of sheet-steel, they are unbreakable. The fact that each fitting has several "knock-out" holes makes possible a great number of combinations from a comparatively small stock of fittings and covers.

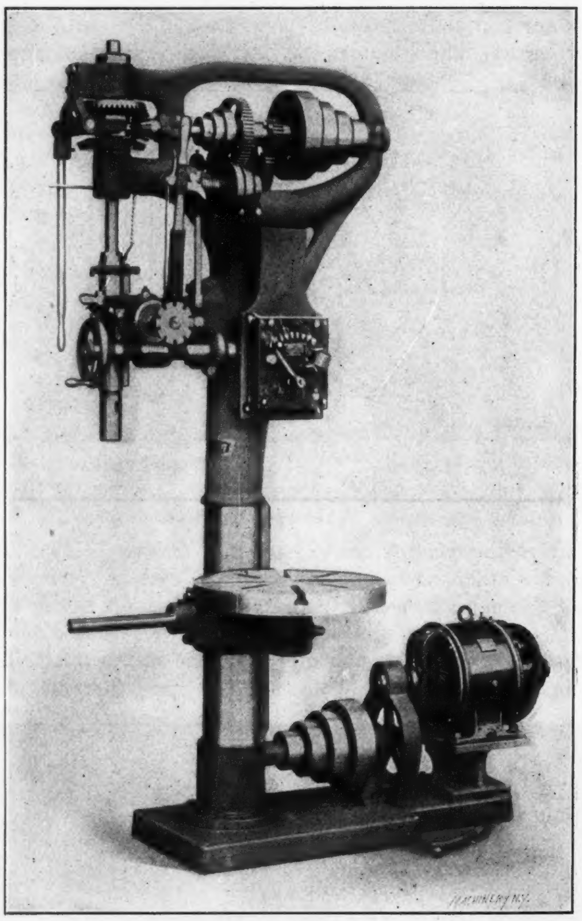


Fig. 15. Motor Starter and Board for Switch Mounted on a Drill Press

Supporting Conduit Wiring

Obviously, conduit carrying conductors should be so securely supported that there can be no chance of its being displaced under reasonable conditions. Pipe straps, formed from sheet-steel and then galvanized, such as that shown with Table VI, are most frequently used for supporting conduit, as shown in Figs. 4, 6 and 7. The dimensions given in Table VI will be found useful in making clearance allowances and in determining the locations for the tapped holes for the round headed machine screws, with which the straps are fastened. The dimensions of Table VI are accurate only for the lines of certain manufacturers but will be approximately correct for all makes.

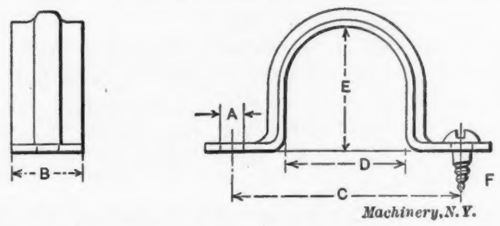
Another good method of supporting conduit runs is by fastening the fitting to the machine frame with machine screws, as shown in Figs. 1 and 8. The screws pass through a hole drilled in the bottom of the fitting and down into a hole tapped in the machine frame. It is often feasible to support a complete conduit installation by this method and there-

by entirely avoid the use of pipe straps. This sort of a job presents a neat appearance.

Motors Arranged for Conduit Wiring

When it is specified that the "motor shall be arranged for conduit wiring," certain motor manufacturers will provide, without extra charge, a metal terminal box, with a removable cover, around the motor terminals. A motor so arranged is shown in Fig. 7. Such a terminal box permits of the best possible installation, and through its presence a conduit fitting, like that at the motor in Fig. 4 can be dispensed with. A hole is provided in the terminal box and the conduit is terminated with a bushing in the hole.

TABLE VI. DIMENSIONS OF PIPE STRAPS



All Dimensions taken from Samples. All Dimensions in Inches

	A	B	C	D	E	F		
Nominal Size of Pipe	Diameter of Screw Hole	Width of Strap	Distance between Centers of Screw Holes	Width of Opening	Height of Opening	Size of Wood Screw to Use (No. in.)	Approximate Cost per 100	Approximate Number per Pound
1/4	0.20	5/8	1 9/16	9/16	17/32	8× 5/8	$0.40	75
3/8	0.20	5/8	1 3/8	11/16	21/32	8× 3/4	0.45	72
1/2	0.20	5/8	1 5/8	7/8	25/32	8× 3/4	0.50	40
3/4	0.22	3/4	2 1/8	1 1/8	1	10× 3/4	0.75	29
1	0.22	3/4	2 3/8	1 3/8	1 11/32	10× 7/8	1.00	21
1 1/4	0.22	13/16	2 3/4	1 3/4	1 5/8	10×1	1.25	18
1 1/2	0.22	13/16	3	2	1 7/8	10×1	1.50	14
2	0.22	1	3 3/4	2 1/2	2 5/16	10×1 1/4	2.00	12
2 1/2	0.25	7/8	4 3/8	2 3/4	2 15/16	11×1 1/4	2.75	6

Switches on Machines

It is required by the Code that every motor and starting box be protected by a double-pole cut-out (fuses or circuit breaker) and controlled by an indicating switch that plainly indicates whether the circuit is open or closed. For motors exceeding in capacity ¼ horsepower, a double-pole switch is required, but a single-pole switch may be used for smaller ones.

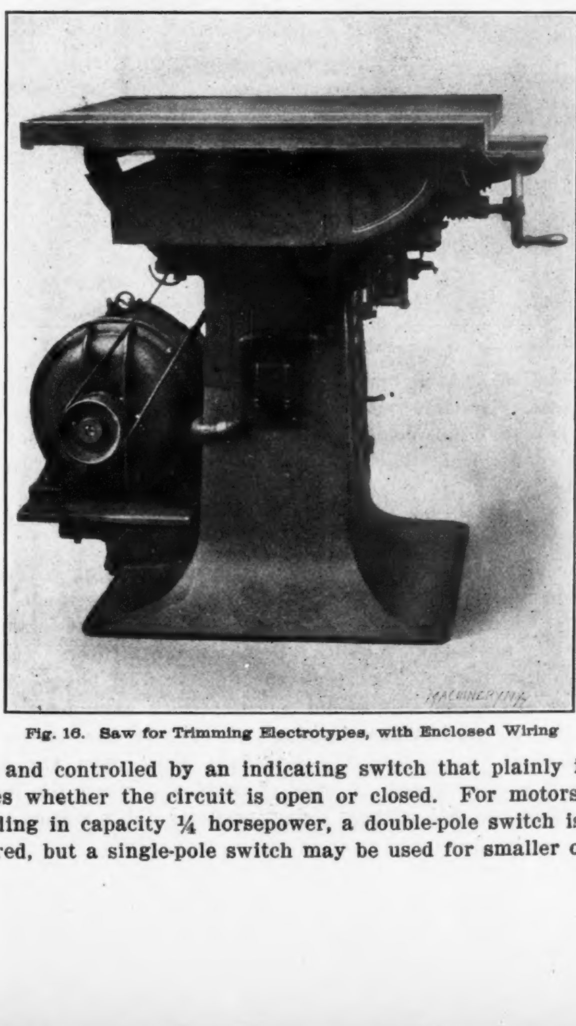


Fig. 16. Saw for Trimming Electrotypes, with Enclosed Wiring

It is always advisable, however, to use the double-pole type, as through its use both sides of a circuit are rendered dead when the switch is open.

For handling currents up to 20 amperes, or thereabout, the best switch to use is of the indicating-snap type, shown in Fig. 9. This type can readily be obtained as either single-pole, for direct-current and single-phase alternating-current motors, or triple-pole for three-phase motors. All "live" parts are effectively enclosed in a formed, sheet-metal cover (Fig. 9) which is lined with an insulating material. By unscrewing the composition handle, the cover can be quickly removed for making connections. Wires enter the switch through holes in the back of the porcelain base. A revolving dial, bearing the legends "On" and "Off," indicates whether the switch is open or closed.

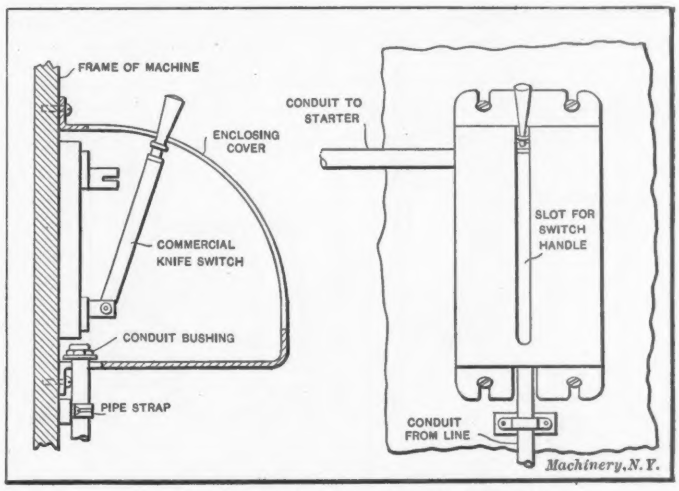


Fig. 17. Enclosing Cover for Knife-switch

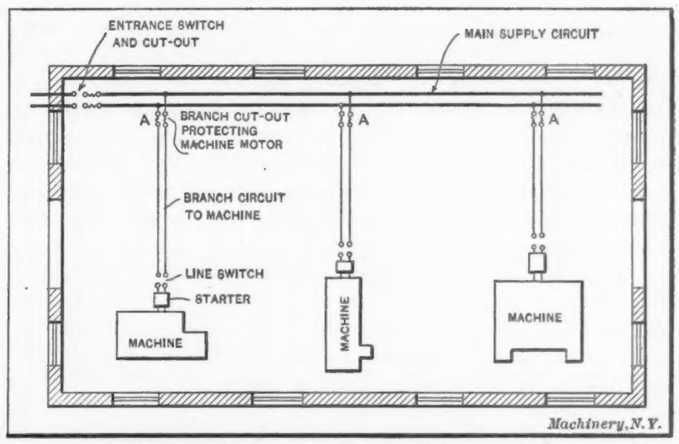


Fig. 18. Wiring Diagram for Motor-driven Machines

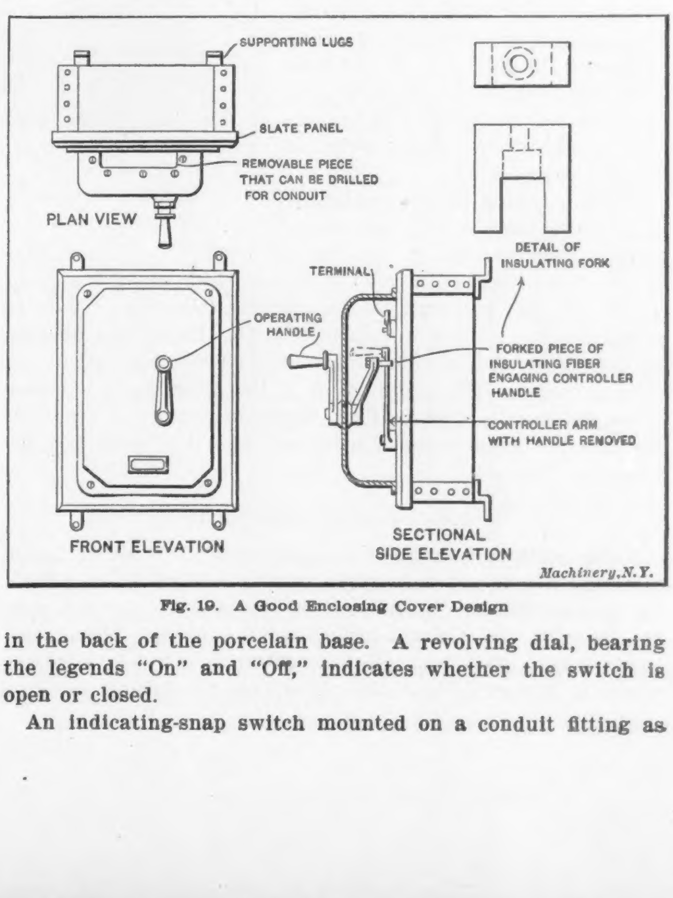


Fig. 19. A Good Enclosing Cover Design

An indicating-snap switch mounted on a conduit fitting as

shown in Fig. 11 makes a rugged and safe switching combination. All wires and "live" parts are completely enclosed. Some manufacturers make conduit fittings especially designed for carrying switches; but an equivalent fitting may be assembled, as shown in Fig. 3 at *K*, with the components *A* and *J*, or with *J* and any other piece shown in Fig. 3.

For handling currents above 20 amperes, open-knife switches are commonly used. The open type is used because (so far as the writer is aware) no enclosed-knife switch is regularly manufactured. These open switches are best mounted close to the motor starter, as shown in Figs. 10, 12 and 13. Controllers and starters, as will be outlined later, can be purchased with the line switches mounted directly on them, as indicated in Figs. 4, 6 and 14. Such combinations are called starting or controlling panels. In Fig. 15 is shown a drill press with the starter neatly mounted on it, and room provided on the mounting board for a line switch. Enclosed wiring is used in Fig. 16 and the leads to the switch are taken from the conduit, at the side of the frame, above the line switch.

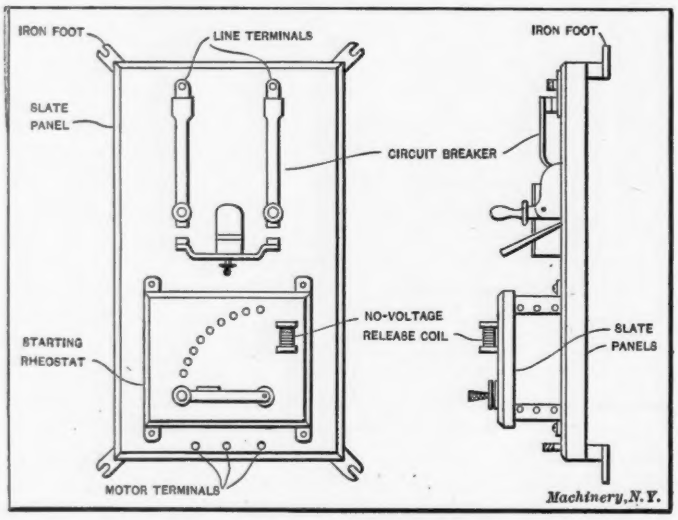


Fig. 20. A Circuit-breaker Starting Panel

In all of these examples of knife-line-switch and controller applications, it was evidently deemed unnecessary by the designer to enclose the switches and controllers. If enclosure is desirable (and as many view it, there are few cases where it is not) a cover for a knife-switch can readily be constructed from sheet or cast metal as suggested in Fig. 17. As will be described subsequently, circuit-breakers are often used on motor-driven machines, making switches unnecessary.

While a cut-out is required by the Code to protect every motor-controller combination, it is not advisable to mount this on the machine. As a rule, it is best located at the point where the branch-circuit to the machine taps from the main supply circuit, as shown at *A* in Fig. 18. Hence the machine manufacturer should not be expected to provide a cut-out. A cut-out is ordinarily required at *A* inasmuch as the branch wires are usually smaller than the main wires and the Code requires the installation of a cut-out wherever there is a decrease in wire size.

Motor Controllers and Starters

Motor starters as regularly furnished by the motor manufacturers are of the open types shown in Figs. 4, 10, 12, 13, 14, 15 and 16. By "open type" is meant a type which does not have its "live" parts protected by a cover. These open starters have given and will give entire satisfaction in places where it is reasonably clean. But some purchasing concerns prefer to have, in so far as possible, all electrical apparatus enclosed, and it is believed that, all things considered, this is usually the most economical method although the first cost of enclosed equipment is a trifle higher. An enclosed starter is shown in Fig. 11. It consists merely of a standard open starter fitted with a cover which encloses all "live" parts, and has a semi-circular slot for the operating handle. Most of the electrical manufacturing concerns have standardized and are prepared to furnish enclosing covers for their control equipment. Such a cover makes it difficult for the unauthorized to tamper with the adjustment of the starter, keeps it clean, eliminates liability to shock and prevents grounds or short circuits due to flying metal chips.

The purchaser of an enclosing cover for a starter should insist that it enclose not only the dial-contacts but also the terminals on the starter. Certain manufacturers will furnish a cover that will shroud the dial and not the terminals, unless specifically directed as above; *all* bare current-carrying parts should be enclosed.

In Fig. 19 is detailed an excellent enclosing cover that can be applied to standard starters. Instead of being slotted for the operating handle as is the one shown in Fig. 11, a better construction is used. An auxiliary operating handle and arm is mounted on the cover; on the end of this arm is an insulating fork which engages the controller arm when the cover is in its normal position, and thus transmits the movements of the operating handle to the controller arm. The absence of a slot in the cover makes the starter dust-proof. The terminals are completely enclosed and a removable piece that can be taken out altogether, for the admittance of wires, or drilled for conduit, is provided above the terminals. When this cover is applied to the standard controller the old controller handle is removed.

Sometimes a circuit-breaker is substituted for the switch on a starting panel, as shown in Fig. 20. A circuit-breaker is one type of cut-out. It opens a circuit automatically when a current, of a value for which it is set, flows through it. It can also be opened manually by releasing a catch. Circuit-breakers, of reliable types, are considerably higher in first cost than a switch-fuse combination, but in the long run they are more economical. The reasons for this are: First, fuse renewals, which are relatively expensive, are not required, and second, the cost of labor wasted while fuses are being replaced, is saved.

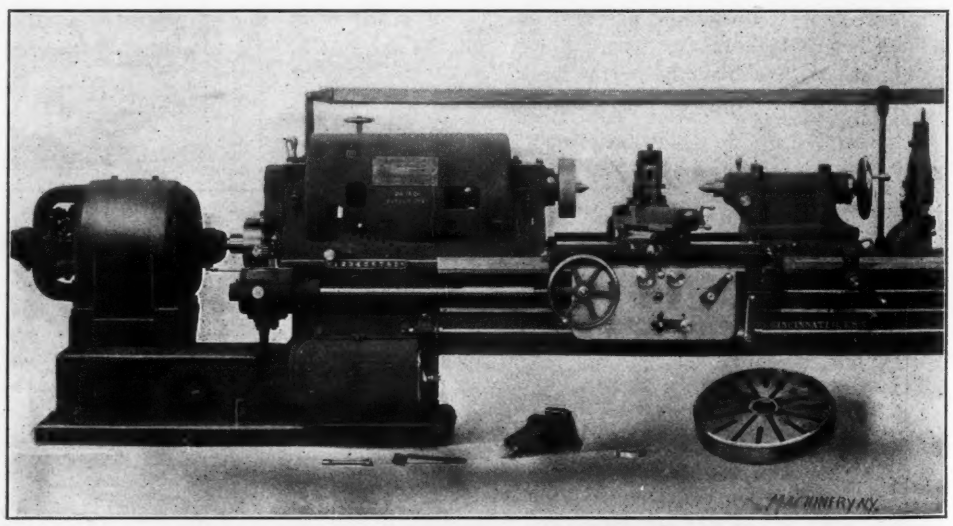


Fig. 21. Drum Controller with Sprocket Mechanical Transmission

The panel in Fig. 20 is shown without enclosing covers so that its construction will be apparent; but it is made with covers which expose only the circuit-breaker and starting-rheostat operating handles. Some manufacturers enclose panels like that of Fig. 20 in sheet-metal steel boxes having hinged doors, but this is not a satisfactory arrangement for machinery applications, because, to operate the starter or manipulate the switch, the attendant must open the door. This is awkward and, in case of accidents, when the motor should be stopped without delay, prevents quick action. The

consequence is that the door is usually left open or is taken off altogether.

As previously mentioned, motors on machines are frequently protected by branch-fuses located at the supply circuit as shown at *A* in Fig. 18, and a circuit-breaker or a starting panel provides additional protection. However, the circuit-breaker should be set to trip on a smaller current than will rupture the fuses. The circuit-breaker takes the brunt of an overload and operates instantaneously, saving the cost of fuse renewals. As the economies of circuit-breaker applications are becoming better understood they are becoming more popular. Some large industrial corporations specify them on every motor starting or controlling panel.

Drum controllers with external resistances are deservedly becoming very popular, particularly for variable-speed control. In Figs. 7 and 21 are shown drum-controller applications. The drum controller receives its name from the fact that contact is made between stationary fingers and rotating segments mounted on a drum. All the parts can be made very rugged and can be so arranged as to be readily removable for renewal and repair. The resistance is arranged in a separate frame which can be provided with an enclosing cover and arranged for conduit wiring as shown in Fig. 7. The drum usually contains only the contact-making mechanism. It is believed that a drum controller is preferable in every way to one of the dial type, which has contact buttons arranged on the face of an insulating panel and a swinging arm to make electrical contact with them.

In Fig. 21 the drum controller is mounted conveniently near the motor at the head of the lathe. The controlling handle, whereby the lathe is started, stopped or has its speed varied, is attached to and travels with the apron and hence is always handily located for operation. The handle engages with a longitudinally-slotted shaft so arranged that when the handle is turned the shaft turns. The shaft extends nearly the entire length of the lathe and motion is transmitted from it to the controller drum by means of sprockets and a chain. It will be noted that the cover of the drum controller can be easily removed by unscrewing a couple of swing nuts.

Enclosing Motors

Motors can be furnished either open, semi-enclosed or fully-enclosed. A fully-enclosed motor of a given horsepower and speed costs more than a semi-enclosed or an open one, because a large frame is needed for the enclosed type. The power capacity of a motor depends largely on its ability to dissipate the heat generated within it, and if it is enclosed, the heat is dissipated with difficulty. To reduce the quantity of heat generated, the parts must be proportioned more generously; hence the necessity for larger frames for enclosed motors. Motors seldom need to be fully enclosed unless they are to operate in very dirty places, or in other special cases. Gauze enclosures such as those indicated in Figs. 11 and 14 are ample for most machinery applications. Gauze or wire-netting enclosing covers reduce the rating of a motor very little, if any. The use of such covers is advocated on motors for nearly all machine drives. One small metal chip, striking a motor in just the right place, can involve more money for repairs and lost time than would be spent for several sets of gauze-enclosing covers. An investment for them is good insurance.

Mounting Motors

The Code specifies that the frames of all motors operating at potentials in excess of 550 volts shall be either permanently grounded or else insulated by wooden frames or otherwise. The use of a wooden frame or any other insulating arrangement is not usually feasible, so the almost universal practice is to bolt the motor frame into good electrical contact with the frame of the machine. It devolves upon the purchaser of the machine to see that it is well grounded, either through the conduit conveying the conductors to the machine (the Code requires that the conduit of all conduit wiring systems be grounded) or through a specially provided ground wire connected to the machine. It should be noted that the Underwriters require that special permission be obtained before motors with grounded frames are installed.

CUTTING SPEED AND GRINDING OF HIGH-SPEED STEELS

By WOLFGANG KOCH

The properties of the so-called "rapid" steels are not yet thoroughly understood, although their use is increasing. They have been well introduced for roughing, and their capacity for this work varies, according to the kind of steel used and the care taken in hardening. But in any case it is well known that the rapid steels rough better and last longer than carbon steels of any of the compositions common in recent years. As regards finishing, it is asserted by some that the rapid steels can only rough, not finish. Without doubt, this unfavorable view is due very largely to the fact that it is often undertaken to finish a piece of work with the same tool that has just been used vigorously for roughing it. No experienced machinist would undertake to finish a piece of work with the same carbon-steel tool that he had used to rough it; but from a new article everything is demanded. The writer has very often found in testing new rapid-steel tools that for a job of roughing which was beyond the capacity of any ordinary steel, it has been demanded by the superintendent, and also by the workman, that the same tool should do the finishing; and it has been considered a fault when the finished work has not been satisfactory. The newly-ground tool finished very well; but after roughing cuts had been taken with it, the edge turned, which prevented it from taking a good finishing cut. It is, in fact, foolish to demand this; but it is a fact that it is demanded.

A second demand made on rapid steel is that tools made from it should finish with the same cutting speed as that with which they rough. No one would demand such a cutting speed of carbon steel; but as rapid steel is expensive, one demands of it in finishing a very much higher capacity in every way; and when it does not act, the conclusion is at once arrived at, that it cannot finish.

If a properly-ground cutter of rapid steel is used, at a somewhat higher speed than is possible with carbon steel, but with by far less speed than is permissible for roughing, it will be seen that its cutting edge lasts longer than one of carbon steel. Therefore, with the same length of work-time, several sharpenings are saved, with the accompanying interruption of the work; and the tool lasts correspondingly longer. But above all things the advantage is that entire pieces of work can be finished without the necessity of grinding, with its consequent change in the cutting edge; so that an entire set of articles will have exactly the same finished surface. By means of a cutting edge of rapid steel, therefore, one gets more regular and more exact work. But the work of the cutting edge depends on the care taken in grinding.

Some mechanics have the impression that especially the German rapid steels, besides roughing well, can be used to advantage for finishing. As basis for decision in this important question of the cutting qualities of the rapid steels, the editors of the *Zeitschrift für Werkzeugmaschinen und Werkzeuge* sent several German firms the following question: "It is stated by some that the rapid steels cannot finish, but only rough. On the other hand, it is known that finishing tools of rapid steel stand up to the work very long. Careless grinding—especially wet grinding—makes rapid-steel tools brittle. What is your experience?"

There were received at the time of writing this paper fourteen answers. In two, the finishing qualities of rapid steels were denied; the twelve others agree in the main with the above expressed opinion as to the finishing capacity of the rapid steel, or at least did not contradict it. Two answers emphasized the fact that the principal advantage of the rapid steels is for roughing, but state that this steel will finish also. Great care in grinding, and the avoidance of heavy pressure while grinding, were often recommended. Nine answers recommended dry grinding for rapid steel, one recommended wet grinding, and one, wet grinding with hot water. One answer stated that wet grinding even with boiling water was deleterious to rapid steel.

As in these answers many opinions are expressed which are worth publishing, they are given in the following:

Gebr. Böhler & Co. write: "If finishing tools of rapid steel do not fulfill the expectations, they have not been properly handled. The grinding of rapid steels must be done with great care, but special care must be taken that the steel does not get too hot during this process, as when heated these highly alloyed steels are very sensitive and show fine cracks, which cause crumbling of the cutting edge. Grinding can be done either dry or wet. As against the advantage of the more rapid conduction of heat by wet grinding, there is a greater danger of cracking, as by the higher heating in grinding, contact with the water causes fine cracks to appear more readily. In order to prevent too great heating, it is imperatively recommended to choose such a grinding apparatus that the attack of the grinding disk shall always be only on a very small surface at a time; this can be attained by choosing small enough disks."

The Krefelder Stahlwerk writes: "It is our opinion that the wet grinding of rapid steel twist drills is to be avoided in every case. The cutting edges break, so that the drill does not do enough work. * * * According to our experience most twist-drill grinding machines in Germany are for dry grinding, so that account has to be taken of this fact. * * * With careful dry grinding, a good edge for finishing may be obtained." It was added that in practice it could not be ascertained whether steel had been manufactured in an electric furnace or otherwise.

The Siegen-Solinger Gusstahl Co. writes: "Rapid cutting steel has the peculiarity that it holds its sharp edge under high heating by reason of high cutting speed; while tools of carbon steel become dull because of the reduced hardness caused by the heating. It is therefore easily seen that rapid steel is better adapted to dry grinding than carbon steel, which thereby easily loses its hardness."

The Stahlwerk Kabel, C. Pouplier, Jr., writes: "I am of the opinion also, that wet grinding should be done by cooling off with hot water. Experience shows that the valuable but very hard steels readily develop, both by dry and by wet grinding with cold water, fine hairlike cracks, which are naturally disadvantageous in finishing; and these fine cracks are often avoided by cooling in hot water. Very often these cracks are caused by improper and careless grinding; and personally I am of the opinion that when grinding is carefully done, the same results will be attained by wet as by dry grinding."

R. Stock & Co. write: "Our experience in grinding rapid steel, especially twist drills, shows that one can grind just as well wet as dry, if careful not to exert too much pressure against the disk. The heat of grinding must remain within the limit which with dry grinding would cause an annealing or a hardening, and with wet grinding would cause surface cracks. With alloy steel one must be careful in wet grinding as well as in dry; whereas with the high alloys a heavier pressure may be permissible. High alloy steels have a grain which is more resistant to cracking than the lower alloy steels; they are, therefore, in dry grinding less sensitive to the resultant heat of grinding. Also with the high alloys, by reason of their more suitable crystalline form, the danger of cracking by cooling during grinding is less than in the case of the lower alloys. As in wet grinding one can do more work by reason of keeping the tool constantly cool than by dry grinding, so one will find it desirable to wet-grind the less sensitive high alloys, and very carefully dry-grind the low alloys. In reference to finishing with rapid steels, our experience is that these are not so good as the carbon steels."

One of the most important German machine-tool builders, who does not wish to be named, says: "We braze small pieces of Böhler rapid steel to Bessemer steel. After the brazing and simultaneous hardening in a strong air current, the steel is brought to the proper form on the emery wheel, with water cooling and moderate pressure, and then ground smooth on a grindstone with slight water cooling. For fine work the tool is further touched up by the workmen on an oilstone. With steels handled in this way we have not yet discovered any cracks.

"In the use of tools for finishing, the different materials to be worked must be taken into account. On a shaft of fine-grained iron (41,000 to 50,000 pounds per square inch tensile strength) a rapid-steel tool will keep its edge a long while with a cutting speed of 60 meters (197 feet) per minute; and at the same time will do good finishing.

"On a shaft of high-carbon steel of 92,000 to 100,000 pounds per square inch tensile strength and a speed of 12 meters (39.37 feet) per minute it was not possible, with the same rapid steel, to do equally clean work, and the life of the cutting edge was very short. The same unfavorable results were obtained later in working tool steel."

Ludw. Loewe & Co., write: "Concerning the exact properties of rapid steel there is as yet too little done in the way of detailed experiment to enable us giving an opinion. Further, the various kinds differ so greatly in their behavior in hardening and working, that an opinion based on one kind would not be accurate for another. In any case we recommend under all circumstances to grind wet, as all steels have this in common, that the edge will be ruined by improper dry grinding. Naturally, wet grinding must also be properly done, and without too heavy a pressure; else the often-mentioned spoiling of the rapid steel will take place.

"In general one can say that the rapid steel is best used for roughing, and that preferably it is to be used for drills and roughing tools. On the other hand, there are also cases where cutters of rapid steel are greatly to be recommended and specially show a great durability, so that the edges need sharpening very seldom."

The Werkzeugfabrik Gebr. Saacke writes:

"According to our experience, wet grinding is in general little to be recommended for rapid steel; and in most cases, we prefer dry grinding. If the latter is done with the proper precautions, with the least possible heating of the cutting edges, these serve very well for finishing. Highly alloyed rapid-steel cutting tools of different makes seem to show very different properties in this regard."

Droop & Rein write: "Rapid steel will do finishing very well; and with reduced speed will do clean work. The edge of the tool lasts four to five times as long as that of the ordinary steel. It is true that careless grinding will make the cutting edges crumble or rather full of cracks. The reason for this is in the heating—because of the pressure—and in the simultaneous cooling with water. The finishing-tool works best when it is carefully ground with a soft emery wheel and finished off with an oilstone."

Biernatzki & Co. write: "We have only recently posted a notice in our factory, forbidding the wet grinding of rapid steel. We have also in our works, and with our machine tools, which are specially constructed for rapid steel, had the experience that water in every case spoils the rapid steel. It cannot, therefore, be worked with water nor ground therewith. For the milling department, for example, and for lathe work, where finishing is done, we use oil as a cooling material, with good results. In the turning department we finish with rapid tools, and get desirable results especially on cast iron."

Richard Weber & Co. write: "It is just as impossible to grind rapid steel with water, as to harden it therein. It will not permit in a warm condition, any contact with water. If for instance tools of rapid steel are hardened in the air which cools them to about 200 degrees C. (392 degrees F.), and then put in water at once, they will crack even in boiling water; also surface cracks will come in the fine edges, in grinding, if the steel which has been heated in grinding is touched by the cooling water. On the other hand, very careful dry grinding will give, with the majority of rapid steels, good finishing edges; but for all that it is to be recommended even here, for the reason given above, not to grind with water. Some brands of rapid steel or more properly of substitutes therefor are less sensitive to water; experiments in finishing with them have given good results."

The Rheinische Electrostahl-Werke write: "According to our experience, rapid steel of various brands is well adapted to finishing, if the grinding is done dry and with the proper care. Wet grinding makes the cutting edges crumbly and unfitted for finishing."

The Sächsische Maschinenfabrik writes: "Finishing steel and iron with rapid steel at high cutting speeds will not give good results, because small particles of metal become fixed on the edge or tear loose and then crack. With lower cutting speed, and by grinding the tools with the proper facilities, the finish will be just as clean as with an ordinary tool steel. The rapid steel is really better, because one can hardly note any wear on it."

The Wesselmann-Bohrer Co. writes: "Grinding rapid steel is in general very risky, and dry grinding with coarse emery wheels is shown to be the method which is the least so. For finishing, this firm prefers cast-steel to rapid-steel milling cutters; for instance for milling the flutes of twist drills."

From the lack of agreement in the answers, it is evident that the entire question has still many puzzling points. Publishing the answers is certainly the best way to clear up the matter. There seem to be kinds of rapid steel which are as a matter of fact not suited for finishing; perhaps this is proved by two of the communications which deny the use of rapid steel for this purpose. As regards wet grinding, certainly for carbon steel that has been hardened in water, this is well suited; for if heating takes place, at the cutting edge which could cause reduction of the hardness, the heated portion can be at once hardened in water.

Dry grinding, which in the case of carbon steel very easily causes annealing of the cutting edge, can, on the other hand, do less harm to the rapid steel, which anneals very slowly.

In favor of wet grinding it is often claimed that it does not endanger the health of the workman. The danger of dry grinding, however, is eliminated in Germany by the requirements of the law concerning dust exhausters.

THE OPERATION AND MANUFACTURE OF MAGNETOS—2

By HAROLD WHITING SLAUSON*

Not only are the majority of motor cars now built equipped with magnetos, but the older types of automobiles and new and second-hand marine and stationary engines are being supplied with this form of ignition as well, and this has created such a demand that it may be said that the annual production of magnetos in this country, alone, can be counted by the hundreds of thousands. The magneto is a delicate machine to construct and assemble and the greatest precision and accuracy are required in finishing its various parts, some of which are shown in Fig. 6. The magneto and its parts are designated as follows:

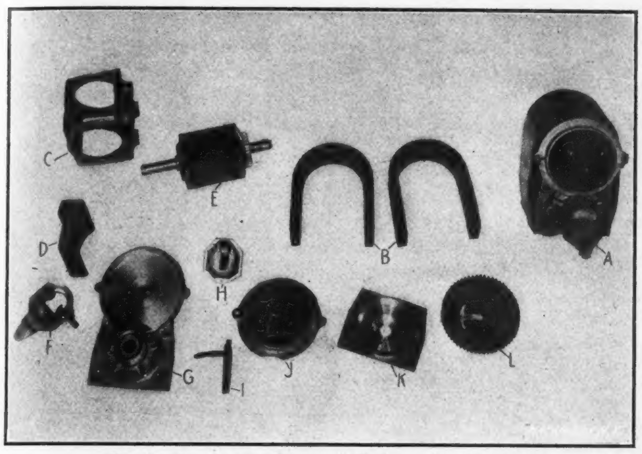


Fig. 6. Component Parts of High-tension Magneto

A High-tension magneto, assembled.
B Magnets composing field of magneto.
C Frame in which armature is mounted.
D Pole piece—forming extension of magnetic field in order partially to surround the revolving armature. There are two such pole pieces.
E Armature and driving gear.
F Timer, or circuit breaker, mechanism and case.
G Distributer case back.
H Timer cover.
I Screw and spring holding timer cover in place.
J Distributer case front and high-tension wire terminals.
K Driving end bearing and case.
L Distributer gear and sector.

Making the Permanent Magnets

One of the most interesting, as well as the most important, features of the construction of a magneto is the manufacture of the permanent magnets that are used to form the magnetic fields of the machine. Should these lose their magnetism, the machine would be rendered useless until the lines of force could be re-established. Consequently it is necessary so to treat the steel that the magnetism will be retained permanently. Soft iron is unsuitable for this purpose, as it will not retain its magnetism unless in contact with another magnet, or except while excited by a current of electricity passing through a surrounding winding of wire. In many instances the permanent magnets are made of tungsten steel. This is cut into bars of the proper length, and each is heated to a cherry-red. Fig. 7 shows the method of shaping a magnet as used in the manufacture of the Kurtz magneto, at Indianapolis, Ind. When heated to the proper temperature, the bar is placed in the clamp, which has already been set at exactly the proper width to hold it firmly in place. A center block, constituting the form around which the magnet is bent serves as the other jaw of the clamp, and is curved at one end to the proper shape for the inside of the magnet. On a long handle, which is pivoted to the under side of this block, is fastened a hardened-steel roller which swings with the handle and follows, in a concentric curve, the shape of the former. This combination of roller and lever serves to bend the magnet to the proper U-shape very quickly, only a few seconds being required from the time the bar leaves the fire until it is ready for the final heat-treating process.

Fig. 7. Bending Magnets to Shape from Bar Steel in the Hercules Electric Works

Hardening the Magnets

After being heated for the proper length of time in a fire of absolutely constant temperature, as shown in Fig. 8, the magnets are cooled in water. As the magnets have already been formed to the proper shape and size, it is undesirable that they should contract to any appreciable extent in the cooling process, and in consequence, each is suspended in the tank of water in a special clamp, which is shown at *A* resting against the pile of magnets. This device holds the magnet rigidly in the proper shape, and as the jaws of the clamp consist of a few small points, the water can reach practically all parts of the surface of the steel.

Fig. 8. Heat Treating the Magnets after they have been bent to Shape in the Hercules Electric Works

Charging the Magnets

After these shaping and heat-treating processes are completed, the magnet is ready to receive—and to hold permanently, presumably—the magnetism with which it may be "charged." This magnetizing is accomplished by placing the embryo magnet in two upright, parallel, hollow bars, around each of which are wound many turns of wire, and through which an electric current is passed. This forms an electro-magnet of the two hollow bars, one being the north pole, and the other the south pole, and this induces magnetism of the opposite kind in the ends of the magnets placed therein. In other words, the end of the permanent magnet placed in the hollow bar constituting the north pole of the electro-magnet, is charged with the opposite kind of lines of force, and this becomes the south pole of the completed permanently-magnetized piece. In like manner, the opposite process takes place in the other pole and the hollow bar. While this magnetizing process is going on, the magnet must be tapped several times in order to distribute and help arrange the molecules properly—for it is on the re-adjustment of the molecules composing the bar of special steel that the magnetism of the completed piece depends. Where magnets are manufactured in large quantities, a special machine, or battery of machines, is provided to facilitate the process. This consists of the

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wire-wound hollow bars, as described above, and a belt-driven spider on which are four or five radial arms, each terminating in a light hammer-head. This spider is revolved rapidly, and is mounted in such a position that the hammer-heads strike the piece to be magnetized with the proper amount of force. Each magnet is kept in this machine for from ten to thirty seconds, and is then tested for its magnetism. Each magnet is tested thereafter several times during the succeeding twenty-four hours to make certain that there is no loss of magnetism during that period, and if at the end of the day it still shows its maximum strength, it is assumed that it will retain this residual magnetism permanently.

Fig. 9. The Winding Room of the Remy Electric Co., in which 2500 Miles of Wire are used per Day

Casting the Bronze Parts

Bronze castings are required in the manufacture of a magneto, and the foundry is by no means the least important part of a well-equipped plant. In one of the largest magneto factories, 8000 castings are made daily, and in order to accomplish this enormous production, duplicate patterns are used extensively. In some instances, as many as 32 duplicate parts will be cast in the same flask at once, and in order to minimize the danger of imperfect molds, pneumatic machines are used for separating the flasks, and compressed air vibrators for loosening the sand around the pattern. Each casting is inspected thoroughly so that only perfect pieces can reach the rough-stock room.

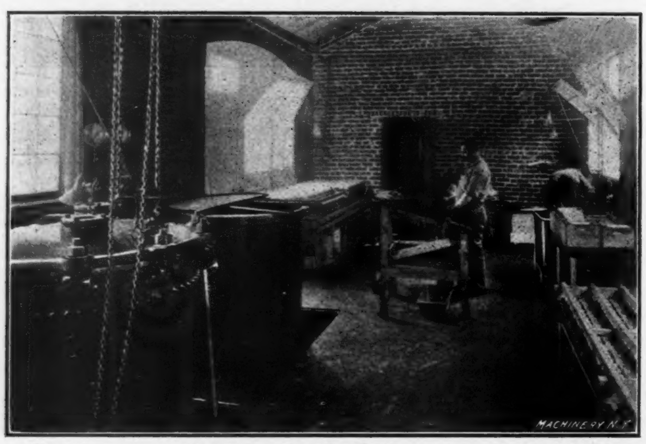

Fig. 10. Impregnating Room in which Coils are treated with Melted Wax or Insulating Varnish

Making the Armatures

After the castings have been machined, those that are to be used as the cores of armatures, coils, or fields are taken to the winding room where they receive the required number of layers of wire. It is important that there should be the proper number of turns of wire in each part of magneto or coil, as it is upon this that the output of the machine, or the proportional increase in voltage delivered by the transformer depends. Most of the winding is done by girls, who become very dexterous at the work. The simple "spool windings" for coils and the like can be made on a high-speed winding machine, but the more complicated process of the manufacture of a direct-current armature requires hand work almost entirely. Fig. 9 shows the winding department of the Remy Electric Co., Anderson, Ind., where over 2500 miles of insulated wire is used daily in the manufacture of the armature and coils. In order to make certain that the proper amount of wire has been put on each winding, and to discover if there are any short circuits or breaks in the insulation, each piece is tested for its resistance by sending a given current of electricity through the winding and observing the readings of the ammeter and voltmeter introduced into the circuit.

Impregnating the Armature Windings

After having been wound, tested, and found perfect, the coils, armatures, or fields, as the case may be, are taken to the impregnating room shown in Fig. 10, where they receive their covering of insulating varnish or wax in order the more thoroughly to separate the individual wires from each other and to protect the whole winding from the outside air and dampness. The impregnating materials are reduced by steam to a liquid state, and the coils to be insulated are heated in a vacuum. Without reducing the vacuum, the impregnating material is turned in, and the vacuum is then changed to a high pressure, thus compressing the liquid wax or varnish

Fig. 11. Battery of Automatic Screw Machines—Each Piece is inspected at the Machine before the Next Operation

into all the interstices of the winding and rendering leakage of current almost an impossibility.

Making the Small Parts of a Magneto

The small parts of a magneto, such as screws, cam, armature shaft, bearings, and the like, require such absolute precision in their manufacture that hand and automatic screw machines, and other automatic machines will be found to play an important part in the well-equipped magneto plant. Fig. 11 shows the screw machine department of the Remy Electric Co. Limit plug gages are used in testing all collars to within 0.001 inch, and in some instances, 0.0005 inch is the limit of variation allowed. In the above named plant each individual part is inspected and tested for size after each operation; and in this manner, a completed part, which may have passed through the hands of ten or a dozen workmen, will not have to be discarded because of imperfections developed in its earlier stages of manufacture. There is an inspector ready to examine every consignment of parts as it is

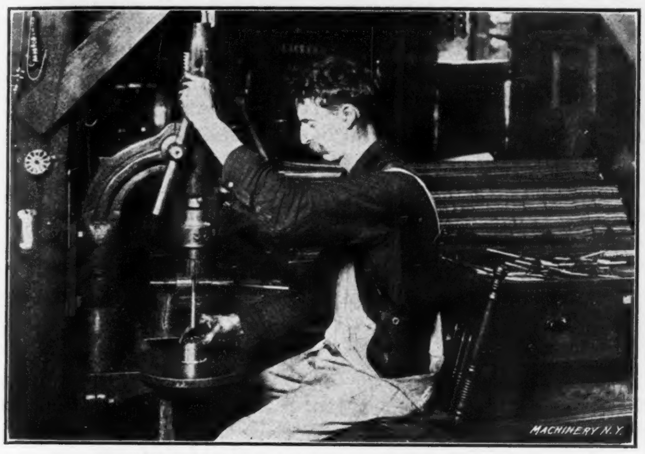

Fig. 12. "Building up" the Laminated Armature of the Direct-current Magneto in the Kurtz Magneto Factory.

finished by each screw machine, and on completion, instead of being sent to the finished stock room, as is generally the case, all pieces are collected at one end of the machine shop for small parts. Here they are assembled, without having been moved more than twenty feet from the machines in which they were made. In other words, the machining, inspecting, and assembling are all performed in the one large room, and there is a minimum amount of transportation of the parts.

Making the Brass Terminals for the Remy Magneto

In the Remy magneto, the high tension wires to the cylinders lead from hard rubber sockets terminating in a split brass shank which has a hole drilled in it of the proper size to give a spring fit to the terminal of the distributer with

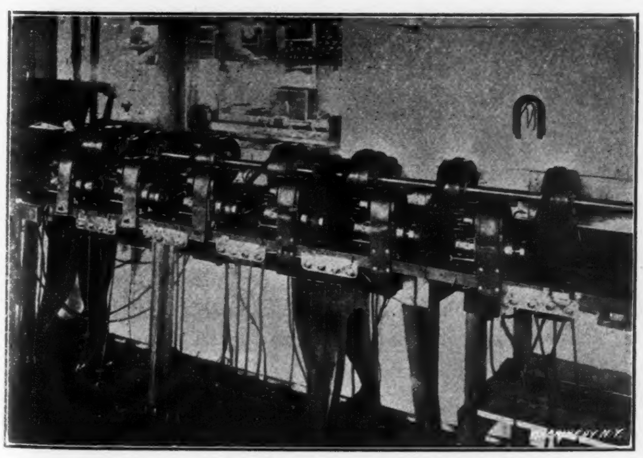

Fig. 13. Testing the Kurtz Alternating-current Magnetos by Belt Power

which each is connected. Each brass terminal is turned out in an automatic machine, and the hole is then drilled in the rounded end. The slotting is done by a special machine built at the factory. This machine consists of a belt-driven circular saw revolving at high speed in a vertical plane. Below this in the same plane, and driven slowly in the same direction by a small belt is a drum in two sections. This drum has threaded holes at frequent intervals in its periphery along the line where the two sections join. One of these sections is divided into segments, each of which is operated by a stationary cam as the drum revolves, thus causing each hole to open and close automatically. The operator places a piece in each

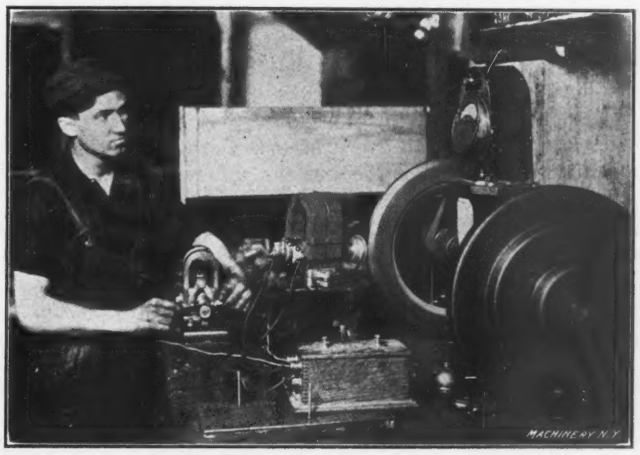

Fig. 14. Testing the Spark Delivered by the Friction-driven Direct-current Magneto. The Spark can be seen jumping between the Ends of the Two Wires between the Terminals of the Coils in the Foreground

hole as it revolves before him, and as this point of the periphery of the drum approaches the saw, the cam closes the jaw and holds the work solidly in position while the brass terminal is revolved through the lower edge of the saw. On the other side of the saw, the jaw is opened by the cam, and the work drops into a trough. An experienced and quick operator can slot with this machine forty or fifty brass terminals a minute.

Construction of the Direct-current Armature

As has been stated before, the armature of the direct-current magneto is much more complicated than that of the alternating-current type. The latter is a simple forging, shaped

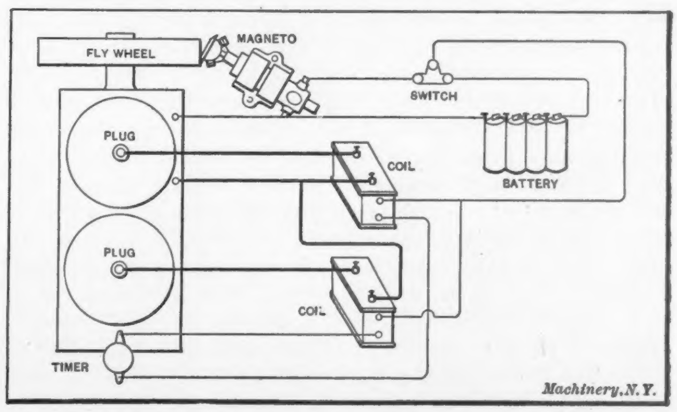

Fig. 15. Diagram of Wiring for a Two-cylinder Jump Spark. This also shows how a Friction-driven Direct-current Magneto may be introduced in the Ignition System to replace a Second Set of Batteries

to receive one continuous winding. The direct-current armature, however, not only has at least six parts of separate windings, or a dozen slots, but in many instances it is built up of thin disks to form a laminated core. The armature of the Kurtz direct-current magneto is manufactured in this manner, and from long experience, it has been found that the best results are obtained if each disk is forced on the armature shaft separately instead of the entire hundred or so forming the armature core being lined up and pressed on all together. Each disk is punched from sheet steel, and is forced on the armature shaft with its companions as shown in Fig. 12. The armature shaft is held in place in a drill chuck having an attachment with a flat face which permits the first disk to be forced on to exactly the proper place. Each disk is held in the proper position so that the slots will line up, by means of a fixture in the bed of the machine. This fixture has a hole in its center to receive the armature shaft, and two pins on its outer edge engage corresponding slots on the disk and serve to hold it steady. The feed handle is released and the armature shaft and chuck are dropped with considerable force on

the fixture and disk, thus forcing the latter into position. The shaft is raised by means of the feed handle and the rack and pinion, and another disk is placed in position on the fixture. Although this may seem like a tedious operation, one man and one machine build up a complete armature of this type in a couple of minutes, and consequently can keep the winding room supplied easily.

Making the Terminal Sockets

Hard rubber is the material best suited for confining the high-tension current within its proper limits, and consequently the terminal sockets, the distributer cover and box, and the distributer disk are all made of this substance. The rubber is molded to shape from soft sheets into which the vulcanizing chemicals have already been introduced. Aluminum molds are used into which the soft rubber, after having been heated on a steam table, is crowded and packed tightly by expert workmen. As there are only a comparatively few different shapes of hard rubber used on a single magneto, the molding and vulcanizing process becomes a duplicate-part-production of the highest type. This will be better realized when it is stated that three and four thousand separate molds are placed in the vulcanizing ovens in a single "heat." Each mold will contain a certain number of ounces or fractions of an ounce of the soft rubber, and it is cut exactly to this weight before the molding process begins. There is consequently no waste whatsoever, and but a minimum amount of time is consumed in packing the molds. The soft rubber is heated in the molds in the vulcanizing oven for several hours. After withdrawal from the oven, the rubber is still soft, but it becomes hard upon being cooled slowly, and after the proper holes have been drilled, is ready for installation on the magneto.

Testing the Magneto

There is such a variety of conditions in the manufacture of the various parts that will affect the performance of the completed magneto, that the testing of the finished machine is an absolute necessity, even though the individual pieces have previously received several inspections. The great difficulty first encountered in the use of a magneto for ignition purposes was due to the fact that it seemed almost impossible to construct a machine that would give a sufficiently hot spark at low speeds of the motor, and yet one which could also be turned at several thousand revolutions with no danger of burning out the coil or other parts of the electric circuit. This difficulty has been successfully overcome, however, by the use of the proper strength of magnets and kind and amount of wire, and the modern magneto will deliver a hot spark at 140 revolutions of the armature shaft, and yet do equally satisfactory work when revolved at twenty times that speed. It is to satisfy the inspector that such is the case, that the magnetos receive their final test. For this purpose, several machines under the charge of one tester will be belted to a common pulley shaft and revolved at various speeds. As shown in Fig. 13 half a dozen Kurtz magnetos are belted in this manner, four spark plugs are connected by high-tension wires to the distributer terminals of each machine. The nature of the spark delivered by the machine to each plug may be observed in this manner for any speed of the armature. The clamps shown in the illustration passing over each magneto are attached to the testing bench, and are sheet-iron strips used for holding the machines in place while they are belted to the pulley shaft.

Inasmuch as a direct-current magneto does not need to be geared positively to the crankshaft of the motor, a friction or belt drive is generally used. It is advisable that the armature of the direct-current machine should revolve at approximately the same speed at all times, and consequently a governor attachment is usually provided with the driving device. In testing out a machine of this type, the bed is clamped firmly in position and the friction pulley placed in contact with the periphery of a rapidly-revolving wheel, as shown in Fig. 14. This would give a high speed to the armature of the magneto were it not for the governor, and the readings of the voltmeter placed above the wheel indicate whether the regulating device is properly adjusted or not. The nature and strength of the spark can be determined in this case by the use of an ordinary vibrating coil and two wires between the high-tension terminals forming a variable gap. The spark is shown in the illustration in question. The other machine shown in this view is a "dummy field" and frame in which all armatures are mounted before final assembly in their respective magnetos. It is known that the magnets composing this dummy field are of the proper strength, and any poor results obtained in the test indicate that the armature is at fault, the discovery thus being made before the final assembly and testing of the machine for which the faulty armature was intended.

The Final Testing

An interesting final test is given to all machines in the Remy factory. Here, also, each magneto is tested for the spark it will deliver at both low and high speeds, but instead of using spark plugs, four variable gaps are provided for each machine. These variable gaps are mounted on a switchboard, each having one fixed terminal and one in the form of a swinging lever which can be moved by hand. The spark is observed with each gap set at the same distance as will be found in an ordinary spark plug, and then this distance is gradually increased until the spark ceases to jump. Three of the gaps are then closed entirely so that the current can easily pass from one terminal to the other with no obstruction, and the fourth switch is opened to a width of two or three inches. Although the whole generating power of the magneto is concentrated at this one gap, the current from so small a machine cannot, of course, jump such a distance. This causes the magneto to "work against itself," and if there were any imperfections or weaknesses in the windings of the machine or coil, they would be certain to assert themselves under such strenuous conditions.

When a modern magneto has once been tested and leaves the factory in perfect condition, it is seldom that it will fail to perform its duty if directions are carefully followed. It cannot be denied, however, that the magneto, though reliable, is a delicate machine, and for this reason no one but an expert, or, preferably, the manufacturer himself, should ever try to readjust or repair a faulty instrument. Even those who understand perfectly the theory of the magneto may be puzzled by some minor adjustment, and it is far better to follow directions and "Return magneto to factory in case of trouble."

* * *

The new Pennsylvania R. R. station in New York City and the tunnels under the Hudson River will be opened to traffic November 27. The four tunnels under the East River to Long Island and the portion of the station required for that traffic were opened September 8. The opening of the Hudson River part of the work will complete one of the greatest engineering projects of modern times, costing approximately $100,000,000. The tunnels are of the most enduring character, being constructed of cast-iron rings lined with concrete 22 inches thick. Heavy trains of Pullman cars will be run through them at top speed without fear of deteriorating effect. An important feature of the construction promoting safety and convenience in clearing up in case of accident, is cross passages at short intervals connecting the tubes. These with foot-paths at the sides afford easy means of discharging passengers and loading them into cars in the parallel tube. Abundant telephonic connections and electric lights contribute to safety of operation. Taking into consideration the use of all-steel cars of heavy construction, the block system, etc., it seems that nothing has been neglected that human foresight can provide, for safe operation.

* * *

In selecting a radial ball bearing to take both thrust and radial load, the Hess-Bright Mfg. Co. advises that 10 pounds of rated radial capacity should be allowed for each pound of thrust load. For a situation involving 150 pounds thrust and 1500 pounds radial, select a bearing rated at $150 \times 10 =$ 1500 pounds for the thrust, and 1500 for radial, or a total rated radial capacity of 3000 pounds. For speeds of less than 1500 revolutions per minute and for heavy duty a thrust and radial bearing combination is preferable.

FLYWHEELS FOR INTERNAL COMBUSTION ENGINES*

By D. O. BARRETT†

In looking up material relative to the design of flywheels for gas engines the searcher is impressed by the scarcity of really usable and practical material on the subject. In works which go into the subject at all deeply the effects of the reciprocating parts, the piston, connecting-rod, etc., are all taken into consideration. This does very well, and it is necessary to make such an analysis for large engines, but the average designer of small engines needs some practical formulas which he is usually unable to find.

This article refers only to internal combustion engines of the single-cylinder, single-acting, four-cycle type with two flywheels. The formulas and deductions which are here presented have been worked up from data from several manufacturers of this type of engine and may be considered to represent average practice.

Diameter.—In designing a flywheel the first point to be settled is the diameter. The practice of different concerns varies considerably on this point, some using a large wheel with small rim, others preferring a small wheel with heavy rim. Of course, other details of the engine influence this to some extent. Engines designed especially for electric lighting have wheels heavier than the ordinary and also usually larger in diameter; this will be spoken of later. The formulas in this article refer to the average engine designed for farm or manufacturing use. When average values are taken the relation between the diameter and the speed is found to follow very closely a certain law. This law for diameters is expressed in the form of the following equation:

$$D=\sqrt{\frac{44,000,000,000}{N^3}} \qquad (1)$$

where $D=$ outside diameter of the wheel in inches.

$N=$ number of revolutions per minute.

The peripheral velocity, V, in feet per minute of such a wheel will be $\frac{\pi D N}{12}$ or substituting in formula (1),

$$V=\frac{\pi}{12}\sqrt{\frac{44,000,000,000}{N}} \qquad (2)$$

For convenience in using, curves have been plotted from the equations as given for the diameters and also for reference for the peripheral velocity. (See Fig. 1.) The velocity curve has been plotted with increasing values downward so as not to cause confusion with the other curve. It will be noticed that the peripheral velocity varies from 2000 feet per minute in the smaller sizes to about 4000 feet in the larger. All these velocities are well below what are considered safe values, from 5000 to 6000 feet per minute.

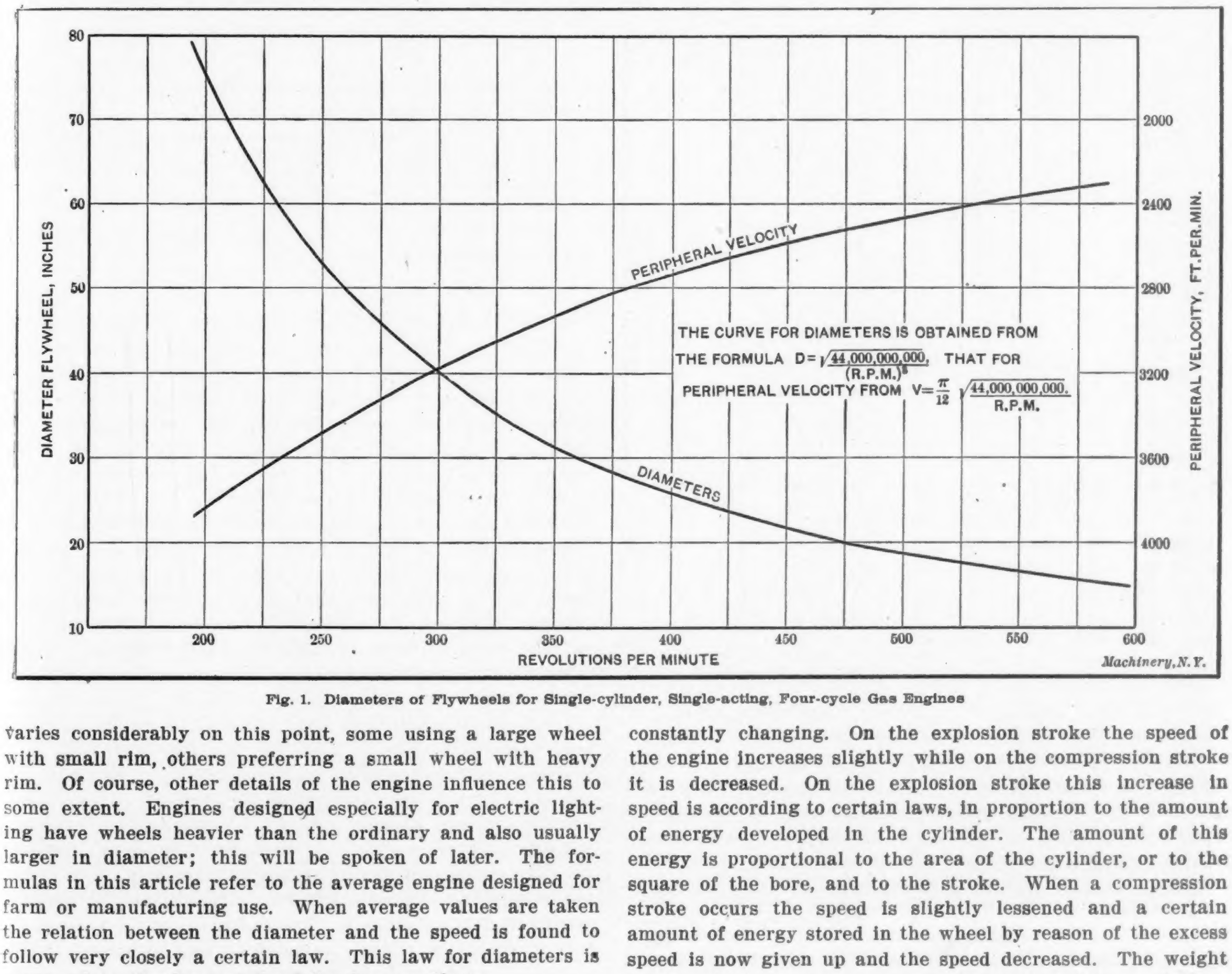

Fig. 1. Diameters of Flywheels for Single-cylinder, Single-acting, Four-cycle Gas Engines

Weight—Rim Dimensions.—The fundamental purpose of a flywheel upon an engine is not necessarily to maintain a perfectly constant speed but to keep the speed variation within certain limits determined by the work being done. When an explosion takes place in the cylinder of an internal combustion engine, were there no flywheel to absorb some of the energy the momentary speed would rise very high and then the engine would, in all probability, stop as there would be nothing to carry the reciprocating parts over the next compression stroke. The flywheel may keep the speed constant over certain intervals as, one minute; that is, the number of revolutions in one minute will be the same as that in the following one. However, the speed over short intervals is constantly changing. On the explosion stroke the speed of the engine increases slightly while on the compression stroke it is decreased. On the explosion stroke this increase in speed is according to certain laws, in proportion to the amount of energy developed in the cylinder. The amount of this energy is proportional to the area of the cylinder, or to the square of the bore, and to the stroke. When a compression stroke occurs the speed is slightly lessened and a certain amount of energy stored in the wheel by reason of the excess speed is now given up and the speed decreased. The weight of the wheel must be so proportioned that these variations in speed are not objectionable for the purpose for which the engine is used.

The energy of a moving body is proportional to the square of its velocity, but the peripheral velocity of the wheel is directly proportional to the diameter and to the number of revolutions per minute. For a given amount of energy in the wheel due to rotation, the weight could be decreased directly as the squares of the diameter and revolutions per minute were increased.

The idea that a large flywheel gives an engine more power is, of course, erroneous, though held by some. It is true that with a large flywheel, as has been shown, the speed will not drop as quickly, yet it will take just that much longer for it to regain its normal speed.

Expressing the above laws in symbolic form, we have

* For previous articles on flywheels and flywheel calculations see: "Simplified Methods of Flywheel Calculations," October, 1909, and the accompanying references; also MACHINERY'S Reference Series Pamphlet No. 40, "Flywheels."

† Address: 87 Lincoln Ave., Freeport, Ill.

$$W \text{ is proportional to } \frac{B^2 S}{D^2 N^2}, \text{ or}$$

$$W = \frac{C B^2 S}{D^2 N^2} \qquad (3)$$

where C = a coefficient determined by practice.
W = weight of the wheel, in pounds.
B = bore of the cylinder, in inches.
S = stroke of the piston, in inches.
D = diameter of the flywheel, in inches.
N = number of revolutions per minute.

For simplicity in the calculations the weight of the flywheel may be considered as being concentrated at the rim; and the mean diameter taken as the outside diameter of the wheel. This, of course, credits the rim with more than its actual weight but as no allowance is made for the arms and hubs the assumption is sufficiently accurate for all practical purposes. The weight of the rim is equal to πD multiplied by

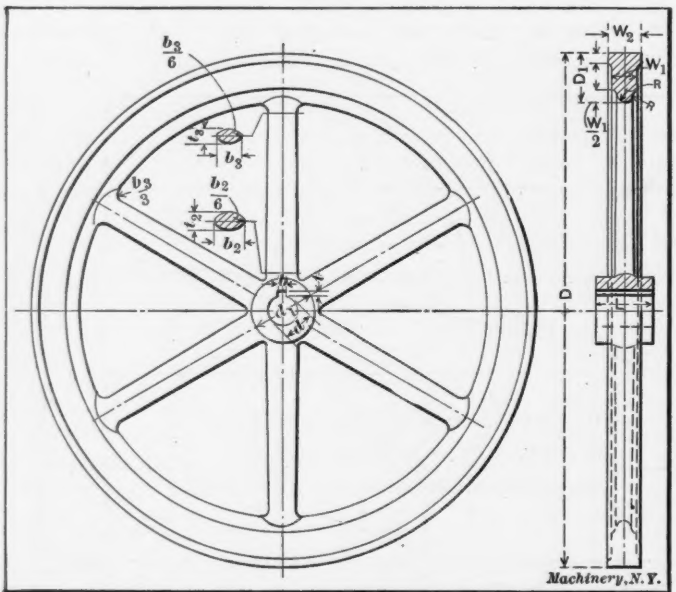

Fig. 2. Proportions of Flywheels for Single-cylinder, Single-acting, Four-cycle Gas Engines

the area of the rim section and by 0.26. (0.26 is the weight in pounds of one cubic inch of cast iron).

Substituting in (3) we have

$$A \text{ (area of section)} = \frac{C}{0.26\,\pi} \times \frac{B^2 S}{D^2 N^2} \qquad (4)$$

Referring to Fig. 2, W_1 is the width or thickness of the rim while D_1 is the depth. D_1 is usually made about 1.9 W_1.

$$D_1 = 1.9\,W \qquad (5)$$

The area of the section of the rim may be said to be equal to $D_1 W_1$ or 1.9 W_1^2. This is another assumption but the metal added at the extreme outer diameter to produce the widened rim is about equal to that cut away from the inner side of the rim to form the rounds.

Substituting in formula (4)

$$W_1 = \sqrt{\frac{C}{1.55} \times \frac{B^2 S}{D^2 N^2}} \qquad (6)$$

The values of the coefficient, C, in the above equation were worked out for a large number of wheels both by substituting the dimensions of the section in formula (4) and also using the weight of the wheels in formula (3). These values averaged quite closely, and 110,000,000 was chosen as representative of good practice. Where engines are to be used for electric lighting or where a closer speed regulation is desired than that afforded by the ordinary engine, it is recommended that a coefficient of 160,000,000 be used. The diameters, D, of such wheels are also usually increased from 10 to 20 per cent. For common practice formula (6) then becomes

$$W_1 = \sqrt{\frac{110{,}000{,}000}{1.55} \times \frac{B^2 S}{D^2 N^2}} \qquad (7)$$

By means of this formula the dimensions of the rim can be obtained directly. See Fig. 2 for references.

W_2 is usually made equal to W_1 plus one-half to one inch.

$$W_2 = W_1 + (1/2 \text{ to } 1 \text{ inch}) \qquad (8)$$

The depth of the widened portion is made from one-half inch in the smaller sizes to one and one-half inch in the larger. The radii of the rounded portion are one-third the width or $W_1/3$.

Arms.—The arms of flywheels are usually six in number though in the smaller sizes five are sometimes used, while above 60 to 70 inches eight are employed. A cross-section through the arms is in the form of an ellipse this making a strong and neat-appearing shape.

It is best to give the dimensions at each end of the arm as then the patternmaker can shape these and then taper the arm gradually from one to the other. To give a symmetrical appearance to the wheel the dimensions of the arms should be made a function of the diameter.

The width of the arm at the hub should be

$$b_2 = 0.058\,D + 0.4 \text{ inch} \qquad (9)$$

The width at the rim is eight-tenths that at the hub:

$$b_3 = 0.8\,b_2 \qquad (10)$$

The thickness of the arm is 0.55 times the width:

$$\text{or } t_2 = 0.55\,b_2 \qquad (11)$$

$$t_3 = 0.55\,b_3 \qquad (12)$$

In drawing the section for the elliptical arm a radius should be used at the ends of the major axis equal to 1/6 the width of the arm. The longer radius should then be so determined that the arc drawn will pass through the end of the minor axis and be tangent to the other two arcs. For rounding the arms into the rim a radius one-third width of arm is used.

Hubs.—The diameter of the hub should be approximately twice the diameter of the shaft or

$$d_1 = 2\,d \qquad (13)$$

Length should be from 1.75 to 2 times the shaft diameter

$$L = (1.75 \text{ to } 2)\,d \qquad (14)$$

Many firms use the split hub, that is, a slot is cored through the hub separating it into two parts. One advantage of this type of construction lies in the fact that rather loose fits on the shaft may be quite readily tightened. In putting on the wheels it also facilitates the operation somewhat. A wedge is driven into the slot expanding the bore of the hub, when the wheel may easily be slipped into place and the hub bolts then tightened. With this type of hub it is also possible to use straight keys, thus dispensing with the cutting of the taper keyway although the advantage of this is somewhat dubious. Where hubs are bored the proper size for the shaft and the finishing tools are kept the proper diameter, shafts being standard, the solid hub is perhaps as good as any except for the larger sizes.

Keys.—For the solid hub wheels it is necessary to use taper keys to prevent endwise movement on the shaft. In order to extract the keys readily they should be provided with gib heads. Wedges may then be driven in behind the key and it may be removed without difficulty. When driving keys it is not necessary to use the largest sledge that can be obtained with the consequent danger of breaking the hub; they should be driven with the ordinary-sized hammer, and if properly fitted will hold indefinitely. The end edges of the keys on the bottom should be slightly rounded so that either in driving or removing they will not cut into the shaft. The keys should be so fitted that the gib heads are within from one-half to three-quarters of an inch from the end of the hub. Nothing is more unsightly than to see a key projecting a considerable distance from the wheel and, by the way, nothing is much more dangerous either, besides occupying a lot of good space which should be used for the pulley hub.

One concern uses a square key having a taper of 3/16 inch per foot. The keyway is cut about four-tenths of the total depth in the shaft and six-tenths in the wheel.

The key width may be made according to the formula:

$$b = 0.17\,d + 0.15 \text{ inch} \qquad (15)$$

Nothing has been said as to the practice of attaching pulleys to the flywheel, as the author does not favor this construction. This is a cheap construction as it does away with the long crankshaft, but it requires a special pulley which can only be obtained from the manufacturer of the engine.

TOOLS AND DIES USED IN THE MANUFACTURE OF JEWELRY*

By CHESTER L. LUCAS†

Three hundred tons of jewelry per year, the product of one factory alone, seems enough to adorn a good share of the American people, at least for a year, and yet in the city of Providence, there is a factory with this output to its credit. The Metal Products Corporation, of Providence, R. I., manufacturer of component parts of jewelry, uses each year 300 tons of "low brass"‡ and it is said that they are the largest consumers of "low brass" in the United States. The factory buildings are occupied jointly by two companies owned by the same stockholders. These companies are the Metal Products Corporation and the Screw Machine Products Corporation, of which the former is much the larger. In these two factories are made component parts for nearly every form of jewelry. These parts, a representative group of which is shown in Fig. 1, are used by the jewelry manufacturers in making up their goods. For instance, a small concern making, we will say, hat-pins, buys the stems, heads, mountings and ornaments for its goods and merely does the assembling, plating, carding and selling. By this method of doing business it does not have to make dies and tools and maintain a department to get out the small number of parts used. The finished goods are not necessarily similar to competitors' who buy parts of the same company, for a thousand-and-one different combinations of parts and plate and color can be arranged to suit individual designs.

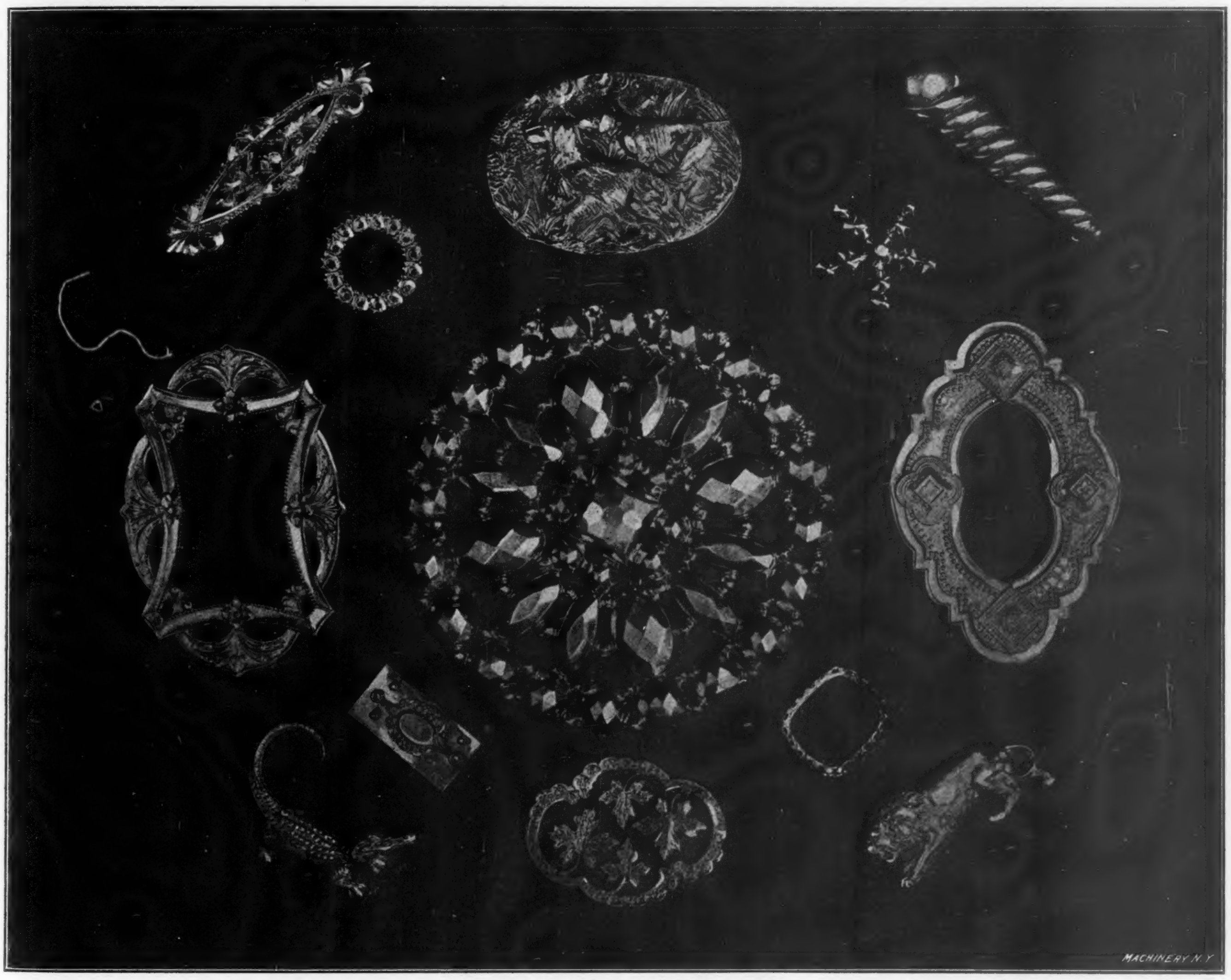

Fig. 1. Specimens of Jewelry Components

Tool- and Die-making Department

Needless to say, the tool- and die-making department of the Metal Products Corporation is the important factor in the success of the factory's product as a whole; for without good tools and dies it is impossible to get out good work. The tool-room, shown in Fig. 2, is a well-lighted room on the north side of the factory and is well equipped for making the tools used in the factory.

Originating Designs

In getting out new patterns and designs of jewelry, the first step is, of course, to draw up the design on paper. The next step is to cut the embossing or striking die as it is sometimes called. Then, the stamping which is struck up in the embossing die, is used as a templet in making the piercing and trimming dies, this collection of dies, embossing, piercing and trimming, constituting the set of tools for that particular pattern.

Making the Embossing Dies

The making of embossing dies is a very slow and costly process, for the die-sinkers who do the work receive double the wages of the average machinist and thus it does not take a very intricate design to make the die-cost very high. The pieces shown in Fig. 1 are specimens of embossing die work.

At one side of the main factory is a brick storehouse in which is kept the stock for the factory; one section of this building is partitioned off and used as a storeroom for embossing dies. In this room are packed embossing dies for 10,000 different patterns and the dies are valued at $250,000—a quarter of a million dollars tied up in dies! The master hobs from which many of the dies were made, and by means

* For other information on die-sinking and the manufacture of jewelry and kindred subjects see MACHINERY, "Coin and Medal Dies," June, 1909; "The Champney Process of Die-sinking," June, 1909; "Dies and Methods for Making Watch Crowns," December, 1909, engineering edition; "Interesting Molds for Finger Rings," December, 1908.

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‡ The terms "low brass" and "high brass" refer to the amount of zinc in the alloy, and are used only in connection with rolled and drawn metals. The usual composition for "low brass" is 75 to 88 per cent copper and 25 to 12 per cent zinc. "High brass" is usually 66 2/3 copper and 33 1/2 per cent zinc. "High brass" is the common brass of commerce being of a light yellow color. "Low brass" has a dull reddish tinge and is used mostly for stamping and bending operations.—C. L. L.

of which the dies could be easily replaced if broken or worn out, are all kept in a large fire-proof safe.

Janvier Die-cutting Machines

Fig. 3 shows a corner of the die-sinker's portion of the tool-room, and a Janvier die-cutting machine is shown to the right of the engraving. The working of this machine is much simpler than the American machines made for the same purpose, and the Metal Products people claim that the work far excels that of any other machine on the market.

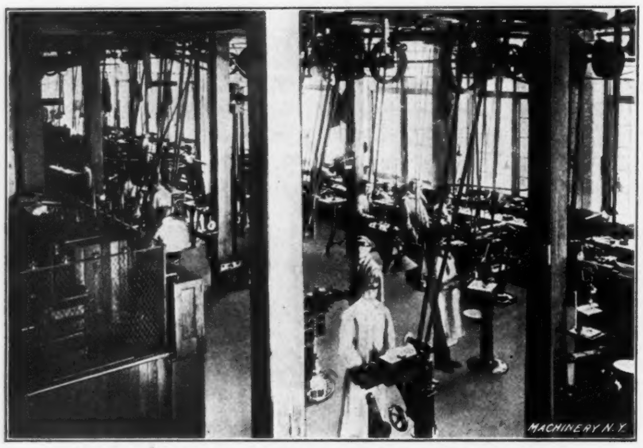

Fig. 2. The Tool-room of the Metal Products Corporation

These machines will not finish a die completely, nor will any of the other die-cutting machines—the finer details must be sharpened up by hand before hardening. However, the design is followed so closely and the work is done so quickly that even with this hand retouching the result is a better and cheaper die than could be made by means of all hand-work.

From the original drawing of the pattern is made a wax model, enlarged about ten times. A plaster-of-paris copy of this model is then made, and lastly a brass casting is made. The brass model is then cleaned up and mounted on the master-plate of the machine and the die blank is mounted on the work-holding plate. Both die and master pattern turn slowly at the same speed. A tracer rides upon the face of the pattern as the pattern turns and follows every detail of the design, starting at the center and working outward. The motion of the tracer, proportionally reduced, is transmitted to the cutter that works at right angles to the die, similar to an end-mill. The face of the die is kept flooded with oil and although the movement of cutter and die seems very slow, a die is cut in from six to twenty hours according to its depth and size. At the bench at the left of this illustration is shown a die-sinker at work finishing up a die cut on the machine. Thus we have the machine and the man combining their work, and the result is a perfect die. Hobs may be cut just as rapidly as dies on this machine. It may be well to explain what is meant by a hob—it is a block of steel with the design cut in relief, just as the finished work will appear. The hob is hardened and driven into another block of steel which becomes the die. Hobs are employed when the design can be more easily cut in relief or when there is likely to be a number of dies made of the same pattern. After the die is made the hob is laid away for future use, should it be needed. The embossed piece just above the center of Fig. 1 was made from a hobbed die.

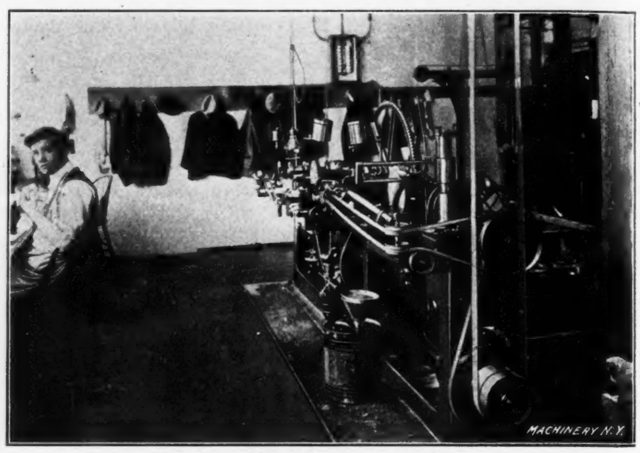

Fig. 3. The Janvier Die-cutting Machine

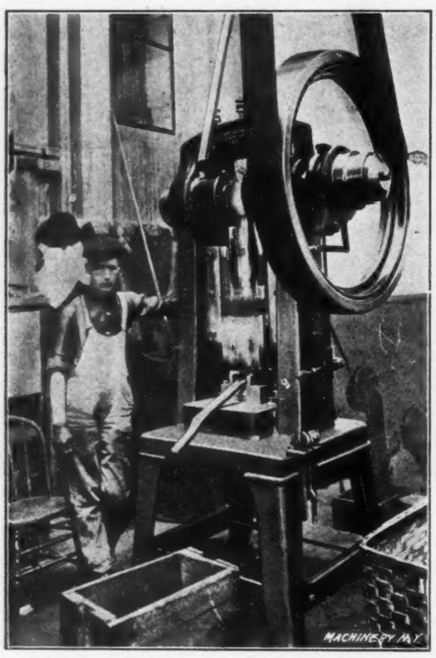

Fig. 4. Embossing and Shearing Press

Trimming Dies

After the embossing die is finished, a striking is taken from it, and carefully sawed out so as to leave a templet whose outline is the exact shape of the embossing die. The blanking or trimming die is then made to fit this templet. In making this die the chief requisite is that it shall fit the outline of the embossing die perfectly, leaving not a particle of stock around it, and of course the die must cut clean and leave no burr.

Fig. 5. A Row of 150-pound Drop-presses

After the center of the die is drilled out in the usual way, the die is mounted in an inverted milling machine and the surplus stock removed as close as possible to the outline. One of these machines may be seen in Fig. 2, in the central background with the operator standing beside the post. Trimming dies and piercing dies as well, are made of comparatively thin steel, being from ½ inch to ¾ inch thick, according to the design; therefore, by placing a taper cutter of the desired bevel in the spindle of the machine, the die can be

milled out close to the outline and the clearance angle cut at the same time. The great advantage of this type of machine is that the work is always in plain sight. After the die is milled out, the diemaker clamps it, face up, over the edge of the bench, by means of a special parallel clamp. Then, seated in a low chair that brings his eyes close to the die, he holds his file in a vertical position through the die and with both hands under the die, he files to the line very rapidly. This method of die-filing is universally used in jewelry toolmaking, and is considered superior because there is little tendency toward rocking the file, and besides, as one of the men expressed it: "You can always see what you are doing."

Piercing Dies

Piercing dies are made in much the same manner as trimming dies. From the embossing-die templet, the irregularly shaped holes are laid out upon the die and drilled and filed out to shape. Considerable ingenuity is necessary to make dies for some of the patterns, as sometimes the holes are closely spaced; too close in fact to make a practical die. In some of these cases the piercing is divided into three or four dies, each of which pierces a few of the holes, so that it is possible to have the holes in each of the dies widely scattered, and yet by using the dies successively, every one of the many openings is pierced. An essential point in piercing dies is good alignment of the punches. One good method of reaching this end is to make each of the punches of a piercing die from round stock and shape the punch back only about ½ inch, the rest of the punch being left round. The stripper for the die is made thicker than usual—about ½ inch—and the holes for the punches round, closely fitting the bodies of the punches. Thus the stripper performs a double duty—stripping the stock and guiding the punches exactly like a sub-press. This method is very inexpensive and though it is not employed in many shops it can be used in patterns where the openings are not long and narrow. More care must be taken in making piercing dies than is necessary when making trimming dies, for each of the openings is a piercing die and must register perfectly with the other openings. Unless

Fig. 6. Foot- and Screw-press Department

the dies work perfectly in this respect, the result will resemble some of the poorly printed multi-colored posters that are inflicted upon us, on which the various colors do not register. Piercing and trimming punches, unless for exceptionally long jobs, are left soft, to facilitate refitting and also to avoid hardening troubles.

Automatic Press Work

Fig. 4 illustrates an automatic press for embossing and shearing small jewelry stampings like the one shown between the alligator and the center piece in Fig. 1. The embossing die is at the rear of the press and consequently as the stock enters from the rear, the first operation is that of stamping. The edge of the embossing die is ground so as to correspond to the lower blade of a pair of shears, and when the stock has advanced after being embossed, the top shear severs the stamped piece from the strip. The pieces are trimmed in a separate operation. It will be noticed that the illustration of the piece shows two large "dots" at one end of the piece and one at the other end, all of which are not a part of the design. The purpose of these additions is to make improper setting of the dies impossible, as well as to prevent the stamped pieces from going through the trimming die in the wrong way. These precautions are necessary on a die with a symmetrical design, because punches and dies of such irregular contour cannot easily be made to fit well when reversed and as there is no necessity for such fitting, the "dots" are added to make the dies fool-proof.

Drop-presses

In the manufacture of jewelry, nine-tenths of the embossing is done under drop-presses, for two reasons: It is generally con-

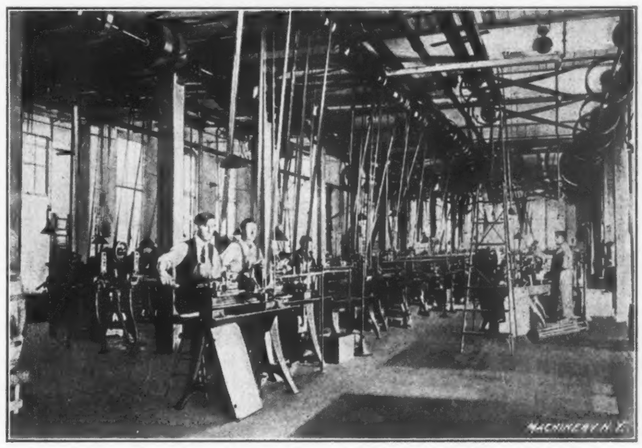

Fig. 7. One Side of the Main Floor—The Screw Machine Department

ceded that the sharp quick blow from a drop-press is more effective for this class of press work, because the blow "sets" the metal in a better manner. In other industries, however, there seems to be a growing tendency to do such work in the ordinary power press, because under proper conditions the work is fully as good and the operation is at least twice as rapid. Another reason and the main point of superiority for the drop-press is its simplicity. There are no shafts to wear or spring, no clutch movements to get out of order, and adjustments may be made to suit any job in a few minutes. For the larger work, automatic drop-presses are generally used, but on the small and medium work plain drop-presses with roller lifts are extensively employed. A row of these presses is illustrated in Fig. 5. The weights of the striking hammers average about 150 pounds. To operate the press the operator places one foot in the strap, which normally hangs about a foot from the floor when the hammer is down. The pressure of his foot brings the roller lift into action and the hammer is lifted. As the operator has both hands free to place and remove the work, there is no time wasted between blows. After placing the work on the die, he raises his foot quickly, which lets the hammer fall, and as it rebounds he drops his foot and holds the hammer suspended again. If an extra heavy blow is required, a pull on the strap with his right hand lifts the hammer to a greater height than ordinarily—to the top of the ways if need be, for the roller lift is very sensitive.

In setting up a drop-press, a good foundation is very necessary. One form of foundation is a long wooden pile driven deep into the ground. Another way is to excavate and build up a foundation of crushed stone and cement. Fig. 5 illustrates a new form of drop-press foundation that has proved very satisfactory. As shown in the center foreground, the foundation is made of concrete with the addition of timbers at the two top edges, which, of course, are added for lagging down the presses. The concrete extends into the ground for six feet. The foundation shown has just been made and is ready for the placing of the drop-presses. The entire row of presses shown along the wall is mounted in this manner and no trouble whatever has been experienced with the foundation.

Foot- and Screw-presses

Foot- and screw-presses comprise an important part of the machinery of a jewelry factory, and Fig. 6 shows one depart-

ment with approximately fifty foot-presses and thirty screw-presses. At first thought it seems rather unprogressive for a factory of this size to be using so much foot- and hand-power machinery, but some of the reasons for their use that were cited are as follows: First, tools may be quickly and easily changed (nearly always by the operators) for the many small orders with which the jewelry factories are filled; second, no expense for power is entailed; third, the first cost and installing cost are low, consequently enough presses may be kept so there will be no hold-up of work for want of machines when orders conflict; fourth, the percentage of accidents is low; and fifth, the space occupied by the presses is small, for they can be packed close together as there are no al-

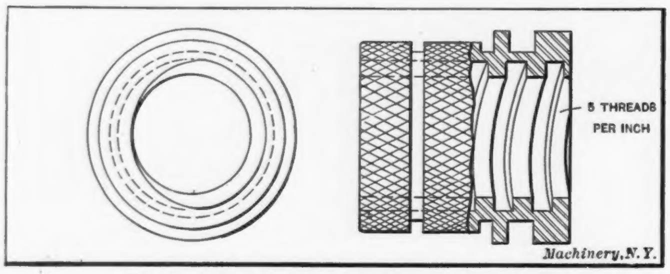

Fig. 8. A Good Job from the Acme Automatic

lowances to be made for shafting of any kind. The foot-presses are used on the small forming and trimming work while the screw-presses take care of the larger work. The largest of this class of work is done with the power presses which are of standard type.

Soldering

In this illustration, Fig. 6, may be seen a typical jewelry soldering bench. Here the girls receive the work that is to be built up, settings, mountings and other component parts, and after setting them up just as they are to be soldered, borax water and small bits of hard solder are applied to the joints and they are ready for soldering. The soldering operation is a simple one and is easily accomplished if the work has been

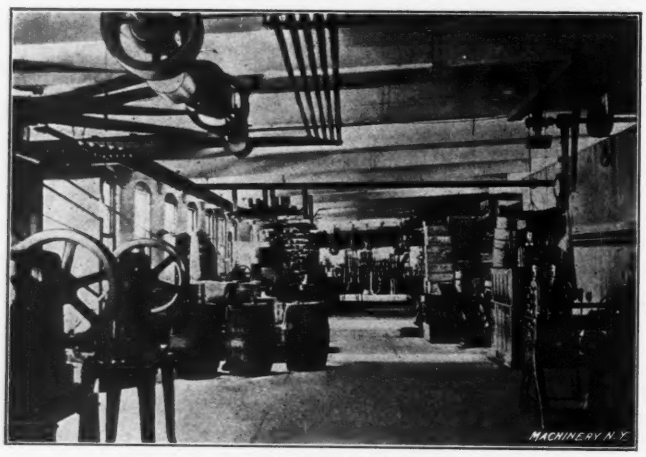

Fig. 9. General View of the Stock Department

properly set up and charged with the solder. With the blow-pipe (fed by gas and air), the first piece at the corner of the pad is brought to the red heat at which the solder flows, and as soon as the solder flows into the joint, the flame is taken away to the next piece. The soldering of a pad of work usually takes but a few minutes while the setting up may take a half an hour or more.

Screw Machine Department

The main floor of the Screw Machine Products Corporation is, generally speaking, no different from any other large screw machine department; but looking beyond the equipment to the product, there are but few, if indeed there are any, screw machine departments that turn out the class and variety of small work that is done here. Small brass balls from 1/16 inch diameter and upwards are turned out by the millions, to be consumed in various industries. So nearly perfect are the tools made and set that the evidences of cutting-off are barely noticeable under a magnifying glass. Brass and iron screws, small posts and studs for the electrical and hardware trades, and many other pieces that can be included under the head of screw machine products comprise the factory's work. Fig. 7 shows one side of the main floor. There are fifty machines comprising Brown & Sharpe automatics, hand screw machines and Acme automatic multiple-spindle machines.

One job that is being done in this factory, and a job that is worthy of mention, is the piece shown in Fig. 8. It is a wrench nut, and up to a short time ago it had been a "bug-bear" to several manufacturers of screw machine products, which fact alone was reason enough for the Screw Machine Products Corporation to attempt the job. The piece is made from 1⅝ inch round machine steel bars, is 1¼ inch long and has a 1-inch hole through the center tapped out with a square thread, five turns to the inch. The other details are as shown in the sketch.

The Acme multiple-spindle automatic, upon which these pieces are made, turns out a complete piece every two-and-one-half minutes. It is unnecessary to say that most of the trouble experienced in starting this job was in tapping the square thread in the piece. When the stock is being drilled, the drill is run in far enough each time for two pieces; consequently when it comes to the tapping operation, there is plenty of room to spare when using a long taper tap, and there is less danger from clogging of the hole by the chips and, of course, there is no chance for the tap to bottom and break. This little kink alone has done much to solve this tapping problem and has saved scores of taps and helped the job to run successfully.

Stock Department

A very important factor in a shop like this is the stock room and although there is little of mechanical interest there, it is at least a valuable department. In this building, a section of which is shown in Fig. 9, a recent inventory showed sheet and rod stock valued at $150,000, and as the $250,000 die storeroom is also a part of this department, it can readily be seen how valuable a building it really is. The department is equipped with rolling mills for rolling special stock to gage, and in addition there are square shears and slitting shears for getting the stock ready for the presses.

The officers of the two corporations are A. C. Stone, president; George Briggs, Jr., secretary; and Harry M. Mays, treasurer.

* * *

THE FIRST TYPEWRITING MACHINE

The typewriter is not so entirely a modern idea as most people assume. The earliest record of efforts in this direction is a British patent issued to Henry Mills in 1714. No record of the construction of this machine, however, remains in existence, as at this early date no drawings were attached to the patents and the specifications dwelt rather upon the object of the machine than the means by which it was accomplished. In the interesting old-English the patent specifications read in part as follows:

"*ANNE*, by the grace of God, &c., to all whom these presents shall come, greeting: *WHEREAS*, our trusty and well-beloved subject, Henry Mills, hath by his humble peticon presented vnto vs, that he has by his greate study, paines, and expence, lately invented, and brought to perfection '*An Artificial Machine* or *Method* for the *Impressing* or *Transcribing Letters Singly* or *Progressively* one after another as in *Writing*,' whereby all *Writing whatever* may be *Engrossed* in *Paper* or *Parchment* so *Neat* and *Exact* as not to be Distinguished from *Print*, that the said *Machine* or method, may be of greate vse in *Settlements* and *Publick Recors*, the Impression being deeper and more Lasting than any other *Writing*, and not to be erased, or *Counterfeited* without *Manifest Discovery*, and having therefore humbly prayed vs to grant him our Royall Letters Patents, for the sole vse of his said Invention for the term of fourteen yeares, Know Yee, that wee," etc.

* * *

It is estimated that the Mitchell-Lewis Motor Car Co., of Racine, Wis., will turn out about $12,000,000 worth of automobiles in 1911.

A SYSTEM OF GAGES FOR SMALL PARTS*

By ILION

The success of interchangeable manufacturing, in the long run, depends more on the worth of the gaging and inspection system in use and the ability to hold the finished parts within practicable limits of variation from absolute accuracy, than

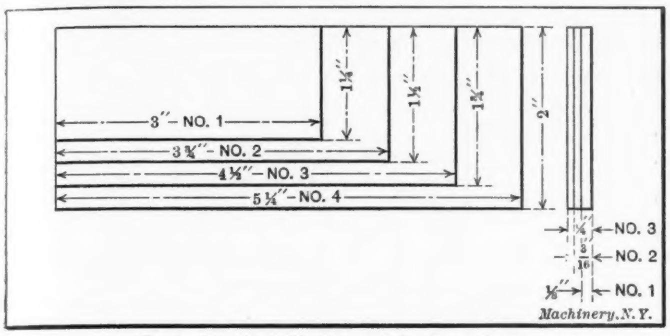

Fig. 1. Standard Blanks used for Snap Gages

on any other factor. A full and complete set of gages and standards must be provided. The system described in the following is used with certain modifications to suit particular requirements, in several factories making light machines, and the salient points are described in detail.

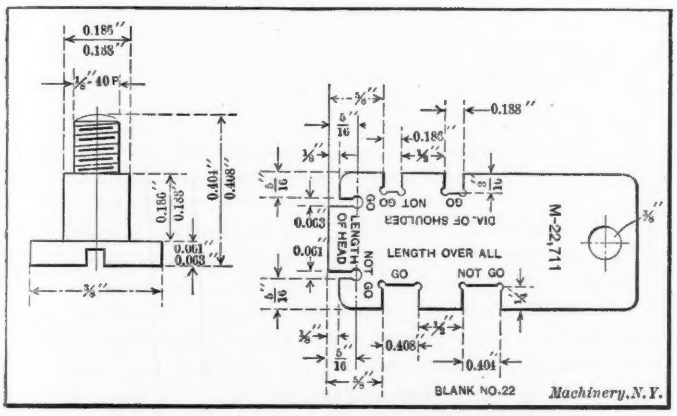

Fig. 2. Completed Snap Gage made from Blank No. 22

Many of the parts of adding machines, typewriters and light machines are comparatively small so that few large or elaborate gages are necessary. Generally most of the gages required are snap gages of the "limit" variety, for gaging the

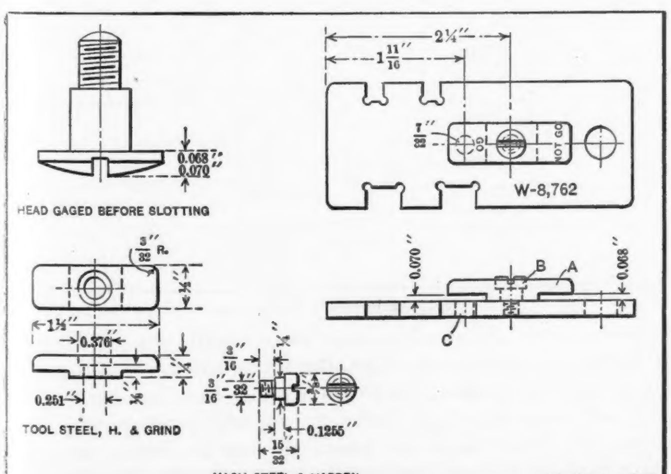

Fig. 3. Snap Gage used in Gaging a Round-head Screw

length and diameter of screw machine product, and the length and thickness of milled work. A set of standard blanks for these purposes is shown in Fig. 1. It will be noted that these blanks are provided in four lengths and three thicknesses, giving twelve different sized blanks to select from. The different lengths are denoted as Nos. 1, 2, 3 and 4, and the thicknesses as Nos. 1, 2 and 3. When called for on a drawing, the two numbers are used in combination as follows: Standard blank No. 11 is one of the smallest length and least thickness; No. 23 is one of the second length and greatest thickness. The blanks are made from machine steel and are carried in stock in the rough in all of the sizes.

Fig. 2 shows a completed gage, and the screw to be gaged by it. Blank No. 22 is used for this gage. The screw is 3/16 inch diameter, and the blank 3/16 inch thick is most con-

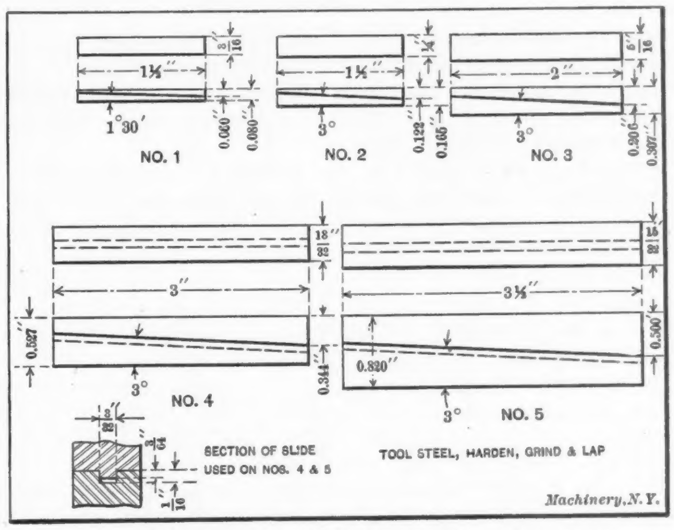

Fig. 4. Wedge Parallels used in Measuring Slots in Snap Gages

venient for handling it. In selecting the size of the blank to be used, a size of blank should be selected in which the slots will not come nearer than 1/2 inch from the end, and 1/2 inch should always be allowed between the slots. This does not apply to the slots on the end of the blank, as they are generally shallow and narrow. Slots are shown on one side for the total length, and on the other for the diameter of the shoulder.

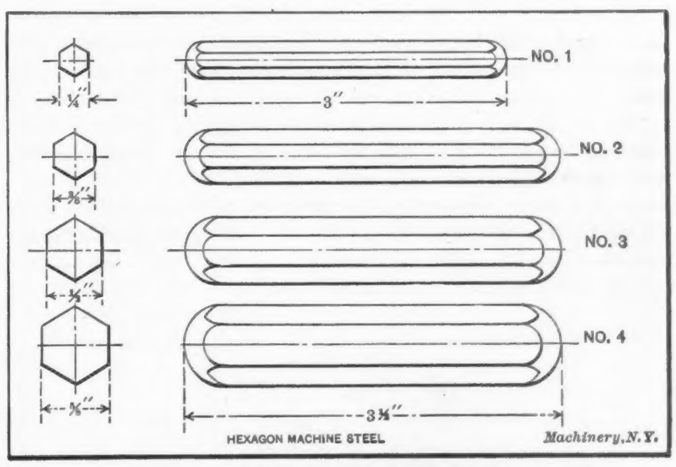

Fig. 5. Standard Handles for Plug Gages

The slots for the length of the flat head are shown on the end of the blank. The maximum slots are marked "Go" and the minimum slots, "Not Go." This has been found to be the most convenient way to designate them. Some firms make the corner next to the longer slot with a radius and the corner next to the shorter with a 45 degree angle, but confusion often results with a new operator, as the reverse method of making the corners is used in other shops. A man having used a set of gages made one way for a long time, often takes some time to become accustomed to the change. With the slots plainly marked, no mistake is possible. A 3/8 inch hole is drilled in the end opposite the one with the slots for the head, for hanging the gage on a screw hook. The large figures near the hole show the part number of the piece to be gaged, the full name of the part and the name of the operation

* For additional information on gages and gage making, see MACHINERY, "Reference Screw Gages," September, 1910; "Accurate Gage Work in the Bench Lathe," May, 1910, engineering edition; "Electric Surface Gage," November, 1909; "Making Thread Gages," February, 1908; and other articles there referred to. See also MACHINERY'S Reference Series Pamphlet, No. 31, "Screw Thread Tools and Gages."

for which it is used being marked on the back of the blank. These gages are hung in the department in which they are used, in rows on racks, with the part numbers arranged in numerical order. It will be noted that the gage shown is made from machine steel and pack-hardened. Most firms

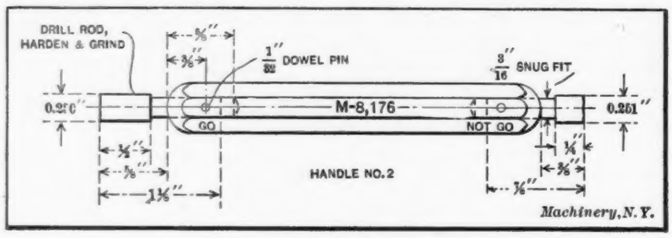

Fig. 6. A Completed Plug Gage

prefer to make them from tool steel and harden them, but the writer thinks that machine steel is just as good and is considerably cheaper. The large figures are stamped before hardening and are later filled in with black enamel, making them show up very prominently.

Fig. 3 shows a snap gage for gaging a round-head screw. In addition to the slots for length and diameter, a swinging

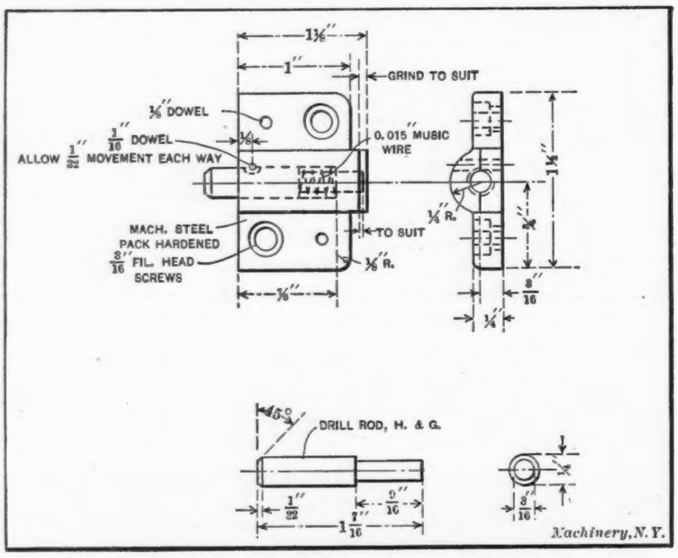

Fig. 7. Detachable Flush-pin Gage and Block

plate is provided for gaging the length of the head. The plate *A* swings on the shoulder screw *B*, and the body of the screw to be gaged is dropped through the hole *C*, the bottom of the head resting on the body of the gage. It will be seen that one end of the plate will pass over the head and the other end will not.

Gage slots are measured by means of wedge parallels, a set of which is shown in Fig. 4. A set of five sizes as illustrated

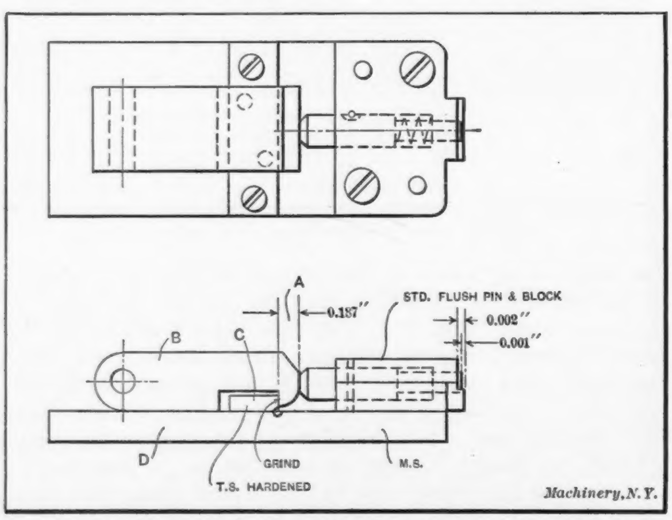

Fig. 8. Application of the Detachable Flush-pin Gage shown in Fig. 7

will give a sufficient range for most work. Each size is so proportioned that it laps over the next larger size by a few thousandths. The parallels are made of tool steel, hardened, ground and lapped. The tongue and groove are used on the two largest sizes only. This method of measuring the slots is not generally known, and the writer believes would be more widely adopted if known.

Fig. 5 shows a set of standard handles for plug gages. These are made of hexagon machine steel. Fig. 6 shows a completed plug gage for gaging the diameter of holes. The gage pins are made of drill rod, hardened and ground, and are a drive fit in the handle. They are secured in place by a small dowel

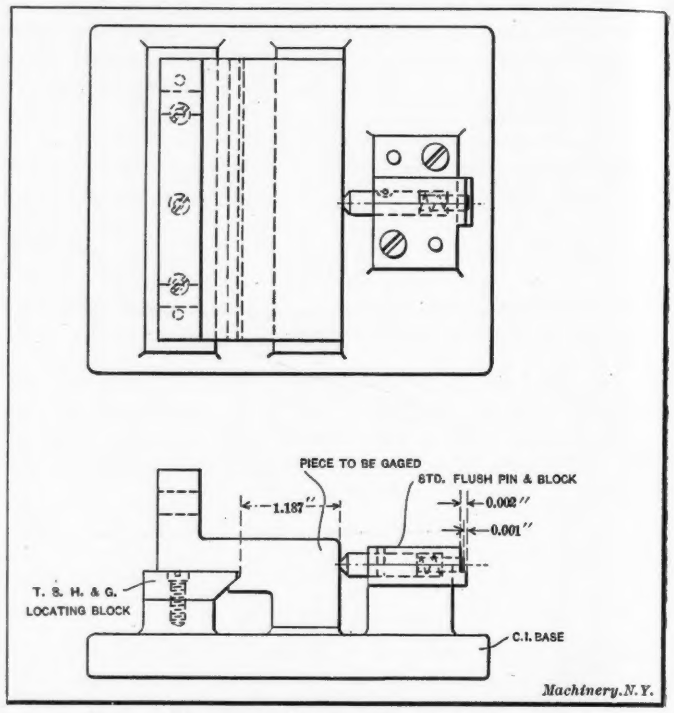

Fig. 9. Another Use for the Flush-pin Gage shown in Fig. 7

pin, and are easily replaced in case of breakage. Some firms prefer to sweat-solder the plugs into the handles, but the advantage of easy removal is thus lost, and the former method is preferable. All the dimensions given are standard, except the diameter of the plugs. These figures have been found by experience to be about right. The plug for the "Not Go" dimension is made shorter than for the "Go" size. This is

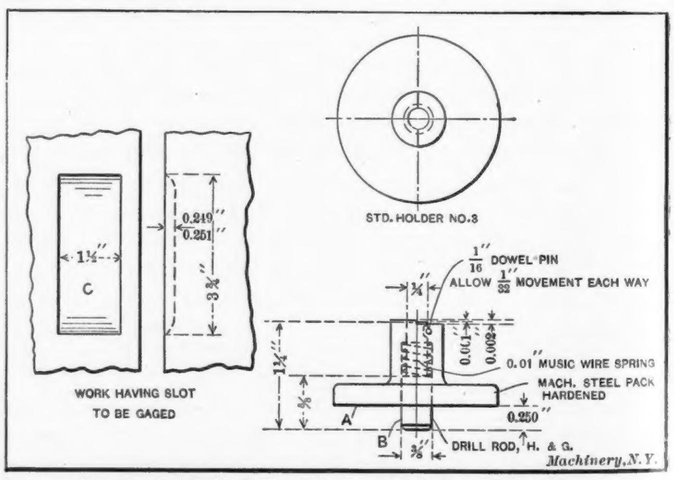

Fig. 10. Flush-pin Gage used for Gaging the Depth of Slots

done in order to make the plugs more readily distinguishable. It might be well to note here, the limits allowed on diameter of holes. In general, they are as follows: For drilled or reamed holes, plus 0.001 inch; for pierced holes, minus 0.001 inch. The plug gages are stored on shelving racks, provided with grooves to hold the handles, and the part numbers are kept in numerical order as mentioned. Square plugs are often used in these handles for gaging the width of milled slots.

Fig. 7 shows a standard flush-pin gage and block of the detachable type. The block is secured to a suitable base or fixture, and the flush pin is used for gaging special shapes which are difficult to measure with any other form of gage. The block and pin are used for a variety of work, so that only the parts shown can be standardized.

An application of this gage is shown in Fig. 8, in which the

dimension A on the piece B is being measured; the limit allowed is 0.001 inch. The piece B to be measured bears against the edge of the hardened tool-steel block C, which is secured to the base D by two screws and two dowel pins. In Fig. 9, another application of the flush pin gage is shown, and it will be clearly seen that the piece to be gaged is of a very difficult shape, and would necessitate the use of an elaborate fixture if gaged in any other way.

Fig. 10 shows a convenient form of depth gage for gaging slots, holes, etc., the depth of which must be held within certain limits. It consists of the holder A, of machine steel,

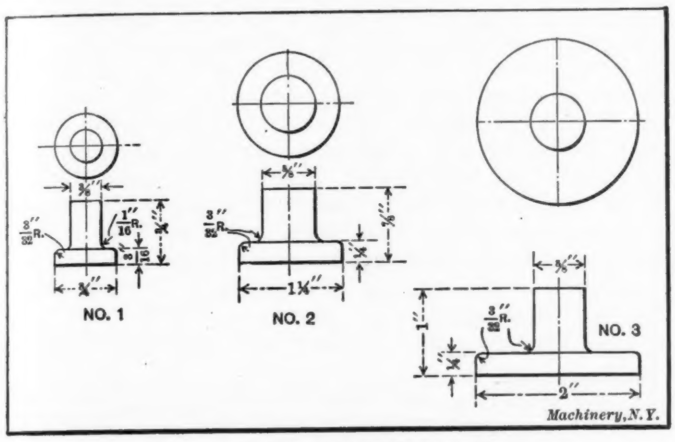

Fig. 11. Standard Bases for Flush-pin Gages

pack-hardened, and the flush pin B of tool steel, hardened. It is intended for gaging the depth of the slot C shown to the left in the illustration. No. 3 of the set of standard holders shown in Fig. 11, is used for this gage. The slot is 1 1/2 inch wide and the holder must be wide enough to bear comfortably on both sides. Another important use of this form of gage is

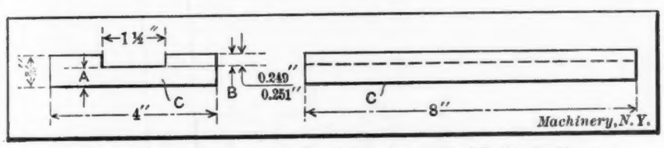

Fig. 12. Example showing the Advantage of a Flush-pin Gage

shown in Fig. 12, where the depth of the slot is to be gaged, the slot extending clear across the piece in which the cut is taken. The usual method of gaging such a slot is to apply a snap gage to both ends of the slot. In this case the dimension A is given instead of B. There are several objections to this method. It is slow compared with the new method, as

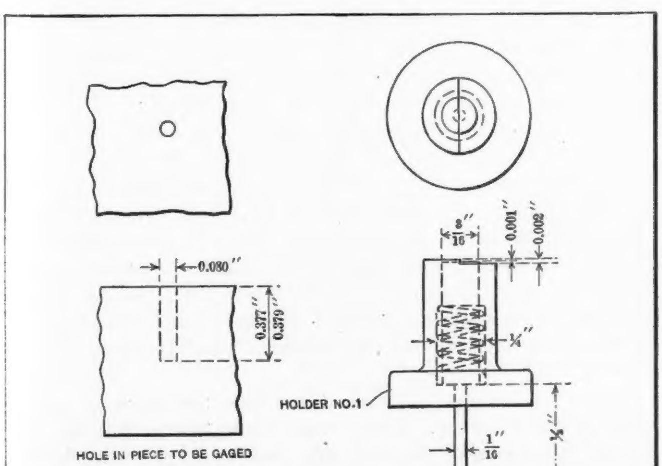

Fig. 13. Flush-pin Gage for Gaging Small and Deep Holes

it is necessary to gage four times, that is, gaging both ends with the "Go" and "Not Go" slots in the gage. The cutter is also liable to ride up and down more or less in the middle of the slot, and the snap gage cannot reach a point far from the end. If there is a limit of say, plus or minus 0.001 inch on the thickness of the block, and also on the dimension A, the error in depth of slot is liable to be doubled. The surface C as frequently happens is not finished, and the snap gage could not be applied in this instance. It is much more satisfactory to apply the gage shown in Fig. 10 to this case, as it can be quickly applied and can be slid along the entire length of the slot, the flush pin showing any variation in the depth at any point.

Fig. 13 shows one of these gages adapted for a bored hole of small diameter. The smallest holder is used and the flush pin is shouldered, to adapt it to the small diameter.

The above examples show about all of the gages in common use which it is possible to standardize. There are, however, many gages of special form employed which are interesting, but they do not come within the scope of this article.

* * *

STEAM ENGINE EMERGENCY REPAIR JOB

By C. W. INGRAM*

The following incidents and facts took place in a machine shop in Great Britain where I first gained the rudiments of engineering:

My tutor was "Matt," the superintendent, who was an elderly man and certainly one of the very old school of mechanics. Matt used to say that an engineer who could solve a proposition on the spot without running off to consult his text-books was the man for his dollar. "Give me the man who can rise to the occasion." This was one of his favorite remarks to all of his men. "I want action in the case of emergency," was his next sentence. "Always have a ready answer; always be thinking of what to do should there be an emergency."

Matt would preach his gospel like this in short jerks as he took his half-hourly walks through the shop, much, of course, to our annoyance, and we used to review all his short snappy sentences during the meal hours.

Our machine shop was a homemade one. Matt made it, and he boasted that since its equipment, he had never spent more than thirty dollars a year for tools, except files; but in spite of our crude machines, the company made money and kept abreast of the modern, up-to-date rivals. Of course we didn't make near the profit they did, but we certainly had good connections with the trade. Our specialty was brass faucets and general sanitary fittings. Any man who could survive one year of Matt's ministry, was indeed a good man, although our shop was not a very good recommendation if he wanted to obtain a position with another company. We hadn't a single slide-rest on any of our machines; we used all hand tools; no taps or dies, so that all threads had to be chased; no countershafts or belt shifters, it being necessary to shift the belts onto the loose pulleys the best way possible. We didn't even boast a cone pulley on any of our machines, which were chiefly of the polishing lathe style. Our chucks were made of lead and when a part had to be turned in the chuck a recess was cut with a hand tool just under the size of the article to be machined, which was then driven in. We had a good stock of old lead and kept a boy busy all the time making chucks for different jobs.

The company paid lots of money for overtime and still made money. Matt's visits to the shop always meant another sermon for me as I seemed to be his favorite target—was never doing the right thing when he was about. I used to meet him out of the shop occasionally, but his whole conversation was shop; he could talk of nothing else.

Well one day when we were extra busy on a special order of faucets and Matt was hustling them through the shops by standing over the men performing the different operations, our little horizontal steam engine suddenly slowed down, and finally stopped. Matt dropped a box of faucets and rushed off to the engine room. The foreman and I quickly followed to learn the cause of the trouble. To the amazement of us all we found a crack on the crown of the cylinder, running longitudinally to the extent of about six inches. The engineer had noticed a fine jet of steam issuing through this crack and he immediately stopped the engine. Well, I thought, here was a chance for Matt to put into practice what he had for a long time preached to us all in the shop. We were busy and the goods must be shipped, and I could distinctly see that these

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facts were running through the super's mind as he gazed on that cracked cylinder.

No one spoke for about a minute, and then Matt turned to us all and said: "Bring some tools here and use your own judgment. Get some waste and a bucket of water and cool that cylinder." While we were running about getting things, a special messenger was sent to a friendly shop to borrow a half-inch tap, and six half-inch hexagon set-screws, one and a half inch long. Within two hours from our stopping we were at work again. Six holes a half-inch deep were drilled and tapped by hand on the crown of the cylinder, and the six set-screws inserted. The set-screws were arranged on each side of the crack and allowed to project above the cylinder. A mold of sand backed up with clay was next made on the crown of the cylinder, and when all was ready, a ladle of molten brass was brought from the foundry, and run in the mold flush with the heads of the screws. All the men stood around while the brass cooled and no one spoke, not even Matt himself. When the patch was hard, Matt went to the steam valve and slowly turned the wheel. The flywheel began to revolve slowly, and as there were no signs of steam leaking from under the brass, Matt grew somewhat bolder and turned on the full steam pressure and sent us all back to our work again.

The engine was an old horizontal type of twelve horsepower, and had been in use years before she came to our shop. She had done service for us about five years when the mishap occurred; that was twenty years ago and she still works as well as ever, but she no longer drives lead chucks. Her old age has brought her to a lower stage, for she now drives a pug mill in a pottery, but the people who own her say that she is still a good engine.

Matt is never tired of relating to me his ability in solving emergencies, and he always refers to the repair made on "that old steam engine." "I knew brass expanded and contracted more than iron," he says, "and I guess that saddle of brass, boy, pulled up that crack."

* * *

FLUX FOR ALUMINUM

For years those who melted aluminum used no fluxes at all on it, not even charcoal, as it was soon found that this material did more harm than good. On account of the lightness of aluminum, charcoal does not readily free itself and is apt to become entangled in the metal and produce small, black spots in the casting. It is only within the past few years that a flux has been used. The flux that is most extensively used, and which has proved to be so valuable is chloride of zinc. It seems to react with the aluminum, forming chloride of aluminum and metallic zinc which alloys with the aluminum. When this takes place the dross is changed to a fine, granular substance which is readily skimmed off. When aluminum is melted, the surface is covered with a rather thick mass, but the chloride of aluminum will change it to a perfectly clear one closely resembling in appearance molten tin or lead. It is needless to say that such clean metal gives better castings. The method of using chloride of zinc as a flux in melting aluminum is simple. Small pieces are thrown on the surface after the melting has been completed. Enough has been added when the surface is clear. A very small amount usually suffices and for 50 pounds of aluminum a piece of the size of a walnut is generally enough. The metal is stirred immediately after the addition and then skimmed. Those who have not used chloride of zinc should try it, as it is an excellent material.—*Edwin S. Sperry in paper read before American Brass Founders' Association Convention.*

* * *

The advantage of high vacuum in reciprocating engines is exemplified by the experience of the Interborough Rapid Transit Co., New York. This company several years ago substituted a barometric type of condenser for a motor-driven air pump and jet condenser, thereby increasing the vacuum on each of their 8000 horsepower Allis-Chalmers engines from 26 to 28 inches, which increased the power obtained from each of the eight units approximately 275 horsepower.

PRACTICAL HINTS FOR DRAFTSMEN*

By G. G. DANA†

In making drawings there are three fundamental principles that should always be kept in mind: First, accuracy; second, legibility; third, neatness.

Accuracy is the first and most important of the three, and too much emphasis cannot be put on this subject. A drawing may be pleasing to the eye, but if accuracy is lacking it is useless for practical purposes, and in some cases worse than not having any drawing. A mistake on a drawing may be the cause of much loss both in money and time, especially in a factory where manufacturing is done on a large scale. For example, suppose four hundred machines of a kind are to be built. Patterns have been made from the drawings and sent to the foundry for castings, which are made as fast as the facilities in the foundry will allow. The whole order might be run out before any of the machines are assembled, and if there has been an error on the drawings, some of the pieces may not fit into their places and may require the making over of one or more parts, which will delay the erecting, besides making the extra expense of producing new castings, machining them, fitting them to their places, etc.; also delaying work all along the line—all of which might have been avoided if a certain figure had not been wrong on the drawing, an arrow point placed at the wrong line, or some other error made. After a drawing is made it should be carefully checked over to see that all dimensions are correct and that the detail figures add up to the over-all figure and that all lines are properly drawn. It is customary in most factories to build a sample machine and test it before the design is approved and manufacturing orders issued to the shop. This gives a final check of the work all along the line, and often improvement will be noticed while building the sample machine that could not have been noticed on the drawing.

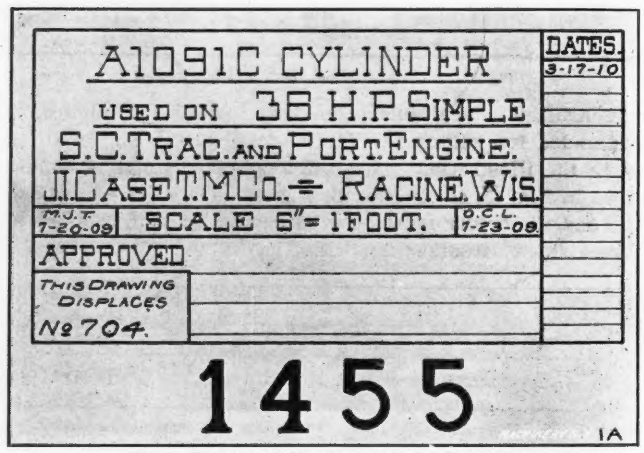

Fig. 1. Sample of Standard Title for Drawings

Under the head of legibility comes the clearness of the drawing or the conveying of the idea that is in the designer's mind. The placing of the views, sections and projections and the arrangement of dimensions, notes, etc., has much to do with the legibility of the drawing. Strive to get all necessary dimensions, notes of explanation, etc., on the drawing, so that those who use it will not have to waste time adding or subtracting dimensions, or figuring out how the piece is to be finished, etc. All of this information should appear on the drawing.

Under the heading of neatness comes the general appearance of the drawing. Good clear lines neatly joined, well-formed figures and letters, and well-arranged dimensions, notes, etc., are among the essentials to neatness as well as legibility.

There might be a great deal more said under each of the headings, but the above will serve as a general guide in the making of drawings.

A good draftsman and designer should be acquainted with

* For additional information on drafting-room practice, see "Some Economies in Making Drawings," MACHINERY, January, 1910; "Sizes of Working Drawings," engineering edition, March, 1909, and other articles there referred to. See also Reference Series Pamphlets No. 2, "Drafting-Room Practice," and No. 8, "Working Drawings and Drafting-Room Kinks."

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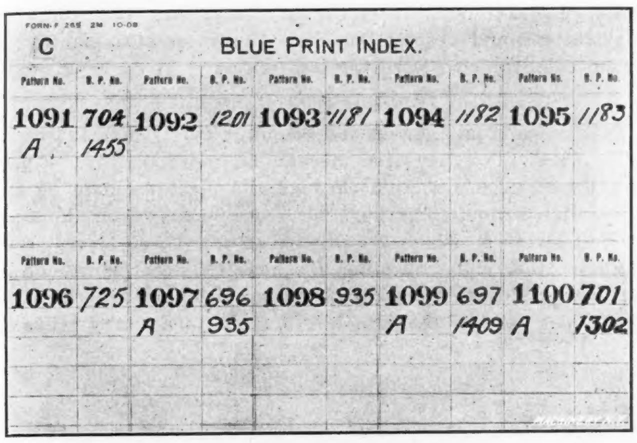
the work of the pattern-maker, molder, blacksmith, machinist and erector. He should be acquainted with pattern-making so that his designs will not involve useless expense in the making of patterns; with molding, so that he will not be designing parts almost impossible to mold or on which there would be time wasted, unnecessary expense in coring out, or other operations which might be avoided if the design were made to conform to good practice in the foundry; with blacksmithing, so that the forging operations will not be unnecessarily difficult or expensive; with the machinist's work, so that the parts will be easily machined and all possible hand work avoided (he must also give the dimensions in such a manner that they will be the ones needed by the machinist in getting out his part of the work); with the work of the erector, so



FORM-F 288 2M 10-08

C BLUE PRINT INDEX.

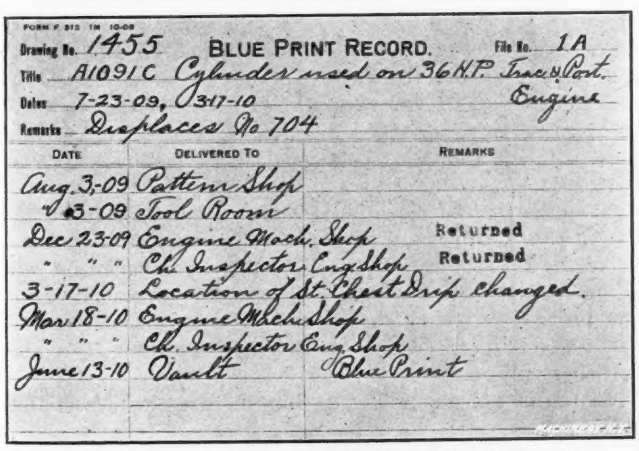
Pattern No.	B. P. No.	Pattern No.	B. P. No.	Pattern No.	B. P. No.	Pattern No.	B. P. No.	Pattern No.	B. P. No.
1091	704	1092	1201	1093	1181	1094	1182	1095	1183
A	1455								

Pattern No.	B. P. No.	Pattern No.	B. P. No.	Pattern No.	B. P. No.	Pattern No.	B. P. No.	Pattern No.	B. P. No.
1096	725	1097	696	1098	935	1099	697	1100	701
		A	935			A	1409	A	1302

Fig. 2. Record Card giving Pattern or Part and Drawing Number

that his designs will go together in the best order without unnecessary filing or scraping. He must figure out in his mind *how* the parts will go together, starting from the foundation and following through the assembling of all of the parts till the machine is completed. In short, the draftsman must be able to follow the work intelligently throughout the whole factory.

In every drafting-room there should be a standard size of drawing which will be most suitable for use in the shop as well as convenient in filing in the drafting-room. Then there will be double-size sheets which can be used when it is impossible to get the work on a standard sheet; also half and



FORM-F 313 1M 10-08

Drawing No. 1455 BLUE PRINT RECORD. File No. 1A

Title A1091C Cylinder used on 36 H.P. Trac. & Port. Engine

Dates 7-23-09, 3-17-10

Remarks Displaces No 704

Date	Delivered To	Remarks
Aug. 3-09	Pattern Shop	
" 3-09	Tool Room	
Dec 23-09	Engine Mach. Shop	Returned
" "	Ch. Inspector Eng Shop	Returned
3-17-10	Location of St. Chest Drip changed.	
Mar 18-10	Engine Mach Shop	
" "	Ch. Inspector Eng Shop	
June 13-10	Vault	Blue Print

Fig. 3. Sample of Card used in keeping Record of Blueprints used by Drafting-room

quarter sheets, which will be useful in many instances for sketches of small parts or for lists of parts, etc. Where the writer is employed, our standard sheet is 18 inches by 24 inches, and all drawings are made on this size unless too large, when a double sheet is used, which may be 24 inches by 36 inches (double width) or 18 inches by 48 inches (double length), the size which is most suitable for the work in question being chosen. The double-size sheets must be folded once in order to be placed in the files.

The classification of the different kinds of work on the sheets is an essential feature to convenience in the shop. For example, cast pieces having the same kind of machining to be done are often grouped together on a sheet; shafting is usually placed on a sheet of its own; forgings on another sheet; pins on another, etc. A standard title is also used which contains the name of the part (or parts) in general terms (see first line, Fig. 1), the machine on which the parts are used, and the firm's name; also a space for the date of original drawing and tracing, which are given at the left and right end of fifth line, and the scale of the drawing. At the right of the title is a space for dates of changes and revisions. Below the title is placed the number of the drawing. The title and number are placed at the lower right-hand corner, which is found to be the most convenient place for reference in looking through a set of drawings.

Every pattern or part has its number. A card record is kept of each piece, showing on what drawing it is found (see Fig. 2, Blue Print Index). Each card has ten numbers, and by using the back of the card ten changes on each number may be recorded. A duplicate of this blueprint index is kept in the shop offices, so that the foreman or his men may refer to it to find the drawings needed for use in their work. A card record is also kept in the drafting-room of each drawing (see Fig. 3). This card shows practically a duplicate of the title on the drawing, as well as a record of all blueprints sent out. Changes made on the tracing are also recorded; this entry being made in red on the card makes it easy to see at a glance what blueprints have been sent out since the change was made. When a new print is delivered, the old one is returned to the drafting-room and record made on the card of its return.

A blueprint of each drawing is filed in the vault after the sample machine has been approved and the drawing found correct or has been corrected to agree with the sample machine.

There are many points that have not been touched upon which have to be worked out for each individual shop or class of work to which it belongs. It has been the writer's aim to touch only points that are suitable for general application.

* * *

PRACTICAL HINTS FOR DIEMAKERS—2

FORMING DIES

By RICHARD L. BREUL*

In making templets and blanks always file them straight and square across the edge. In developing the blank always keep a templet or reference blank, so that it will be at hand if alterations are found necessary. Each time a change is made the previous blank which was kept for reference is marked to designate it from others. The marks may be "M" for model or "S" for sample. It should be remembered that metal will not draw around sharp corners, and that corners over which the metal is to be drawn, should be rounded to a true radius. In all cases when making blanks for forming punches and dies consider the thickness of the metal.

In forming blanks they should always be bent with the grain of the metal and not across it (particularly on sharp bends). By the "grain" is meant the way in which the metal is drawn when passing through the rolls. If it is required to make bends at right angles to each other or approximately so, the blanks should be punched out diagonally across the grain. It is sometimes found necessary to form blanks from unannealed stock, that is stock which has been rolled to a certain degree of hardness. In bending this metal it springs back more or less after being struck in the die. This makes it necessary to make a more acute angle or a smaller radius on the punch and die, than is required on the finished product. This difference can be ascertained only by the cut-and-try method. When producing a short bend in blanks in such a position and of such a nature that the blank slips away from under the punch when it is descending into the die, a spring pad is fitted into the die with the lower part of the bend shaped into it, and flush with the top surface of the die. This holds the metal securely against the punch in its descent into the die and insures perfect duplicates of the product. Where holes in a blank come near a bend, a strain in the metal is set up during the bending operation which elongates the holes. This makes

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it necessary sometimes to pierce the holes slightly oval in the opposite direction before forming. In testing the shape of a forming die before it is hardened, always apply a small amount of oil to the surface so that the blank will not bruise or scratch the die, which would be the case if the die were left dry.

Never leave the inside corners of a die sharp when they can just as easily conform to the radius formed by bending the stock around the punch. This will strengthen the die and lessen the possibility of its cracking when hardened. When necessary one forming die can be made to form bends in several pieces which have the same form but are of different lengths. This is accomplished by equipping the die with interchangeable gages or guide strips. Never leave any file marks on the working portions of the punch or die, as these will be reproduced on the blank. A screw hole in a die should be tapped a little larger than the screw, as the die shrinks somewhat in hardening.

When a punch or die is heated in a charcoal or a soft coal fire, the dust and ashes should be thoroughly scraped off the working portion before dipping, so that the water will have a free action upon the steel. Bending and forming dies, unless there is danger of cracking or breaking of weak parts, should be as hard as fire and water will make them. After hardening they may be warmed over a slow fire until water "sizzles" on them. Some toolmakers, when hardening a punch or die, apply cyanide of potassium to the working portions of the steel before dipping. They claim for this that the outer surface of the steel is rendered harder by the application of this casehardening substance and thus will be better fitted to withstand the wear to which it is subjected. This practice is strongly condemned for this reason: If, as is often the case, the tool should fail to harden, this fact will be concealed by the casehardened outer coating, and the tool will respond to the file test as being hard whether it is or not.

Gage plates should never be secured with two screws and one dowel pin. It is far more practical to use one screw and two dowel pins in most cases. A good method of holding gage plates before their exact position is determined, is to clamp them to the die with fillister screws having washers under their heads; and to drill the holes in the gage plate about 1/16 inch larger than the diameter of the screws, so that the gage plate may be shifted around. Always drill the screw holes for the gage plates through the die so that in case a new gage plate is required the holes will be spotted from the die. Whenever the gage plate comes close to the working portion of the die, cut the punch back far enough so that the body of the punch will come within 1/8 or 1/4 inch of the gage plate. In making gage plates for locating large blanks of irregular shape, they should be made to fit the blank only at the point where accuracy is essential, and not to conform exactly to the irregular shape of the blank.

Wood fiber may be formed in the press into almost any shape, but before shaping, it should be immersed in a solution of hot water and soda for a few minutes and then subjected to heavy pressure in the press.

When setting up a press for forming operations the blank as formed by the tools is used to locate the punch in the die before securing the die to the press. If the tools are being tried out for the first time and no sample has been made, they may be set with strips of metal cut from the stock to be formed. When setting the die for a piece in which the bends are not parallel but off at an angle, it is usually impractical to set them with a previous blank, because when the punch is brought down, the tendency is to push both die and blank away. The more practical method is to locate it approximately with the blank and slightly tighten the screws in the press bed; then with two strips of metal the same size as the blank, gage the exact distance, after which the die can be secured to the press.

Do not pass a die as O. K. when the samples have been produced by bringing down the press slowly by hand, as there is sometimes more or less variation in what the tools will do when operated by hand than when operated by power. Another important point to remember is that it is not advisable to use a punch press for drop hammer work, for a broken crankshaft may be the result.

ADJUSTABLE DIE WORK ON THE ELLIS ADDING TYPEWRITER*

By RALPH E. FLANDERS†

It often happens in interchangeable manufacture that there are a great number of separate pieces to be made, all of which are alike, with the exception of slight differences as to length, angle of bending, etc. When pieces of this kind are to be made by press work, the designer has an excellent opportunity to display his ingenuity. If he is smart enough, he can make one punch and die serve for the same operation on a great number of similar parts. This is, of course, a matter of providing the proper adjustments in the die itself. The typewriter parts of the machine made by the Ellis Adding Typewriter Co., of Newark, N. J., offer an unusual opportunity for exercising ingenuity of this kind. The following illustrations and description show the successful manner in which the problems were worked out.

The Typewriter Action

Fig. 1 is a front view of the machine, partly dismantled, so as to show the typewriter mechanism more plainly. Fig. 2 is a diagrammatic section through the machine showing the typewriter action. The keys at *A* are mounted on the ends of long levers *B*, which are pivoted at *C*. These levers carry at their inner ends roll studs *D*, engaging slots in the end of cam levers *E*, which are pivoted to a stationary "comb" at *F*. The upper ends of the cam levers *E*, in turn, carry studs *G*,

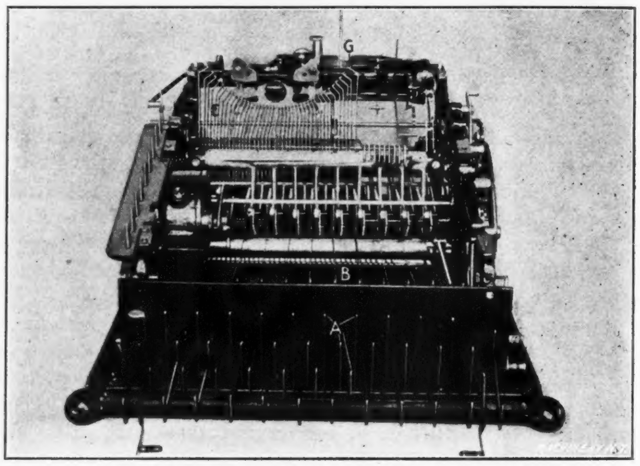

Fig. 1. The Ellis Adding Typewriter Dismantled to show the Cam Levers

which engage slots in the type-bars *H*, which are pivoted at *J* to a "comb" having the outline of an arc of a circle; this gives the type-bars *H* the regulation "basket" form. In Fig. 1 the "basket" of type-bars is removed to show cam levers *E* more plainly. The same reference letters apply to both engravings.

The action of the machine is plainly shown by the dotted lines in Fig. 2. Pressure on key *A* raises stud *D* at the inner end of the type-bar *B*. As stud *D* rises, its engagement with the inclined slot of cam lever *E* throws the upper end of that lever toward the left as shown, and the engagement of stud *G* with the slot in type bar *H* throws it to position H_1 against the paper roll at *K*.

The use of adjustable dies in this mechanism is best illustrated by the tools used in making cam levers *E*. As is shown clearly in Fig. 1, these cam levers are of varying lengths, and are bent at their upper ends to conform to the arc of the circle in which the type-bars are arranged. Many of them, in fact, have two bends, and a few of them have three. The latter cases are made necessary by the provision of openings between the bars for the passage of the "universal bar," against which the cam levers strike just before the type strikes the paper, and thus control the escapement for the carriage movement.

The fact that cam levers *E* are of varying lengths also makes necessary a difference in the angle of the slot at the lower end, where it engages pivot *D*. *D* has the same vertical

* This is the fourth installment of a series of four articles on the construction, action and manufacture of an adding typewriter. The previous articles appeared in the August, September and October numbers.—EDITOR.

† Address: Springfield, Vt.

movement on each one of the whole row of key levers, and the upper end of all cam levers must have the same amount of movement. It is necessary then for the long outside levers to have the slot set at a more acute angle than is the case with the short central levers. Going each way from the center the angle thus becomes a little more acute, so that each lever is different from its neighbor in this particular, as well as in its length and in the number and angle of its bends.

The first operation on this job is that of blanking out the cam lever. One of the blanks is shown lying on the table at *E* in Fig. 4. The blanking die is not shown, since there is nothing unusual in its construction. The blank produced is used for the whole series of cam levers, and so is long enough for the longest, or outside one. Besides blanking, this die pierces the hole for the pivot at *F* in Fig. 2.

An Adjustable Combined Slotting and Numbering Die

Fig. 4 shows the first, and in some respects the most remarkable, of a series of adjustable dies. The purpose of this tool is to cut the cam slot at the lower or enlarged end, and also to number the blanks. The purpose of doing these operations simultaneously will be at once recognized. As explained, the cam slots are cut at varying angles, but the difference in the angle between one lever and the next one to it on either side is so slight that delicate measuring instruments would be required to detect the difference. To prevent the possibility of the levers ever being mixed up, or of their ever having the wrong number stamped on them, the numbering mechanism and the adjustable angle mechanism of the die are positively connected, so that the number stamped on the lever is an absolutely reliable indication that the angle of the slot is right for that particular number.

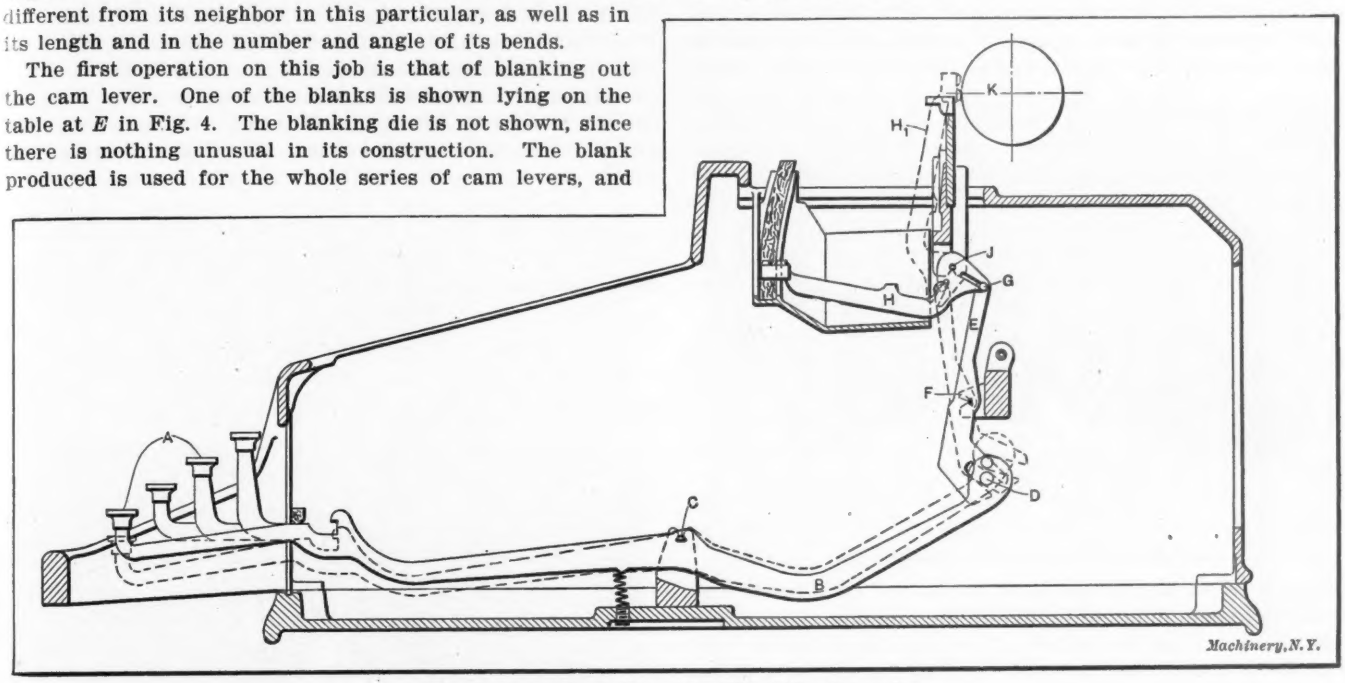

Fig. 2. Typewriter Action of the Ellis Adding Typewriter

The cutting member of the die is shown at *L* (see Fig. 4), the punch which cuts the slot being shown at *M*, surrounded by stripper-plate *N*, which is mounted on the usual spring-supported pad. This holds the work firmly in place during the cutting and during the return of the punch, until it has been drawn clear of the slot which it has cut.

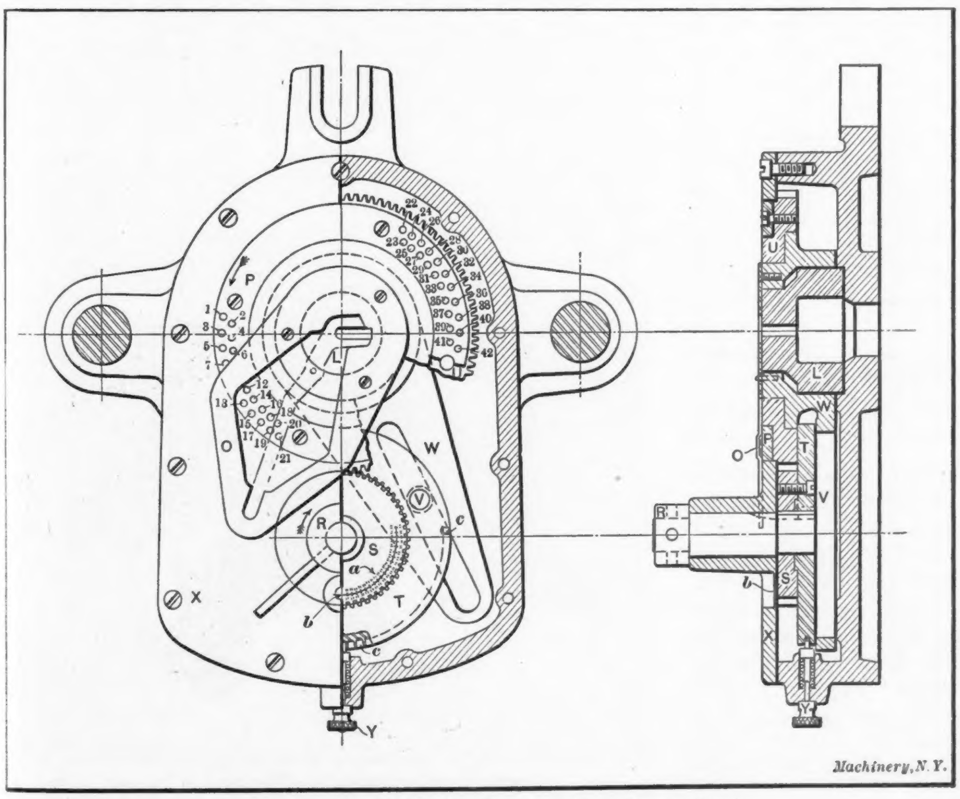

Fig. 3. Details of the Mechanism of the Die shown in Fig. 4

The angle of the slot is changed by shifting the gage-plate *O* which locates the blank, as shown by the dotted lines representing the outline of the latter in Fig. 3. A series of number types is inserted in ring *P*, which may be adjusted to bring the proper number beneath the blank. This number is stamped by the pressure on the blank of pad *Q* on the punch, which may be adjusted in height to give the proper pressure. The movements of gage-plate *O* (which controls the angle of the slot) and of type-ring *P* (which stamps the number), are positively connected, and are controlled by turning capstan head *R*, using for a wrench a pin stuck in one of the holes in its periphery.

The connections between *O*, *P* and *R* are best shown in Fig. 3. Capstan *R* is keyed to gear *S* and disk *T*. Gear *S* meshes with gear *U*, to which type-ring *P* is screwed and doweled. Disk *T* carries a stud *V* which engages a slotted arm *W*, which, in turn, has gage-plate *O* screwed and doweled to it. By means of this positive connection, the movements of *O*, *P* and *R* are made positive with each other.

It will be seen that two revolutions of *R* are required to give the full range of adjustment. The sketch shows the tool set for one of the central cam levers, having the slot at an obtuse angle. As *R* is moved in the direction of the arrow, gage-plate *O* is moved to the right through its connection with lever *W*, making the angle of the slot more and more acute.

At the same time, type-ring *P* is moved in the direction shown by the arrow, bringing the corresponding numbers in place under the work. When the last of these numbers has been reached, a continued movement of *R* for nearly three-quarters of a revolution is required to bring the punch into the next operative position. These positions are for the levers on the other side of the center, which have to be set at the same angles as on the first side, of course, changing from obtuse to acute. But this complete revolution of *R* which

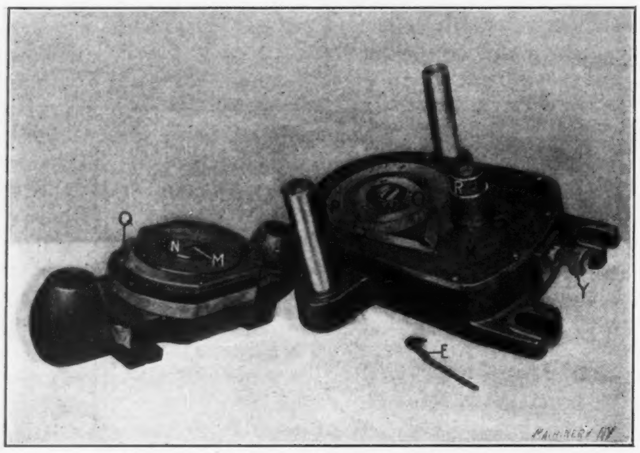

Fig. 4. An Adjustable Die for Slotting and Numbering the Cam Levers

brings *O* to the same position as before, has turned type-ring *P* only halfway round, so that it brings a new set of numbers into action. Thus the second set of adjustments gives work having the same angles of slot as the first set, but with different numbers stamped on it.

The proper adjustment for each number is indicated by the graduations *a* on gear *S*, read through a hole *b* on the top casing *X* of the die. This location for each position is positively determined by spring index plunger *Y*, whose point

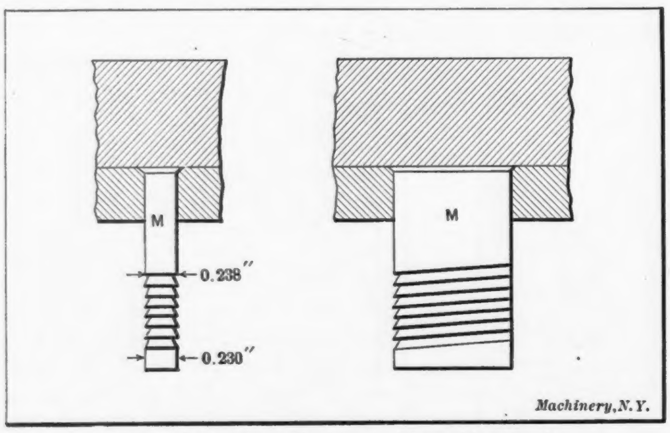

Fig. 5. A Combined Blanking and Broaching Punch

enters holes *c*, properly located to receive it in the edge of disk *T*.

A Punch which Blanks and Broaches at One Stroke

A peculiarity of punch *M* should be noted. As shown in Fig. 5, it is so made as to not only blank out the slot, but to broach the edges as well to a finished size. The lower end of the punch, which is a loose fit in the die, cuts out the blank. Above this blanking edge, it is provided with a series of shaving or broaching teeth. Between the first and the last of these teeth the punch tapers about eight thousandths, leaving four thousandths on each side for a finish. The slot is thus left cleanly and smoothly finished and accurate to size. This construction was a new one to the writer.

Adjustable Die for Cutting to Length

The next operation in making these cam levers is that of trimming them to length. This length is a variable matter, as has been explained. The die for this operation, and also for properly forming the end and punching the hole for the stud, is shown in Fig. 6. The work is located by gage-pin A_1, which enters the pivot hole of the blank. This gage-pin is mounted in a slide Z_1, adjustable in V-ways by means of the knurled screw head B_1. It is by means of this that the length of the different levers is determined. Pointer C_1 shows the proper location of each number of cam lever on a scale attached to the base of the die. A vernier giving the actual length in hundredths of a millimeter is also provided (see D_1) as an added check on the adjustment.

The construction of the punch for this end-trimming operation is interesting. The cut is, of course, an unbalanced one, there being a tendency for the punch to dodge away from the die. To prevent this, pilots E_1 are provided, which enter the rectangular slots provided for receiving them in the die-plate, before the cutting edges meet the work. These preserve the alignment between the punch and die, making flinching impossible.

As shown, there is an elongated slot beyond the cutting edge of the die at F_1, which allows scrap of varying lengths, cut from the ends of the blanks to fall through the base of the die. A pressure plate G_1 is provided in the punch to hold the work firmly while the punching is in progress.

The First Operation Bending Fixture

The first bending operation is performed in the hand-operated bench tool shown in Fig. 7. The work is held in the vise

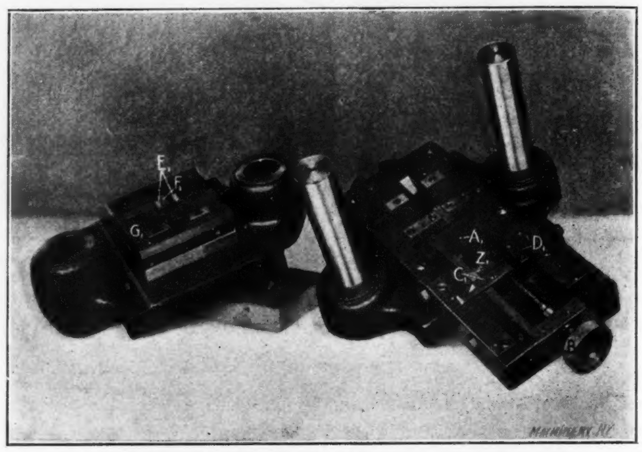

Fig. 6. Adjustable Die for Trimming Cam Levers to Length

jaws J_1, being located by the spring pin shown, which snaps into the pivot hole. The position of the bend is determined by adjusting the slide K_1 on which this vise jaw is mounted, to the proper position on the base of the machine, by means of the knurled-head adjusting screw L_1. The bend is made by inserting the tail of the work into the slot in fixed jaw M_1 and pivoted jaw N_1, the slot in the two being in line, of course, when the work is inserted. Jaw N_1 is mounted on a revolving stud, controlled by handle O_1. The movement of this handle to one side or the other of the center is limited by stop P_1, clamped

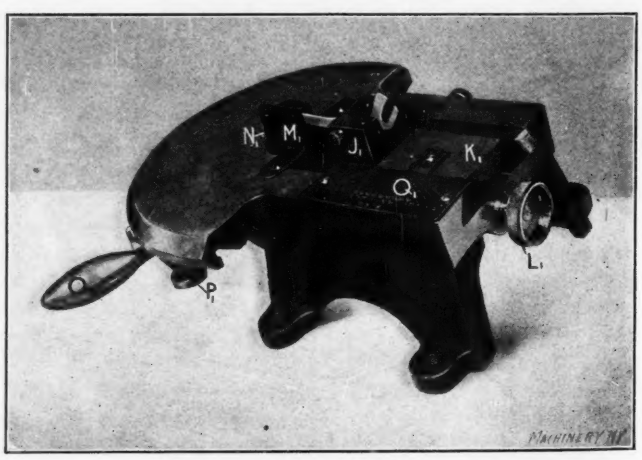

Fig. 7. Adjustable Die for Making the First Bend in the Cam Lever

in a circular T-slot under the circular dial. Graduations on the edge of this dial enable the stop to be set to the proper position for each of the different cam levers, as indicated by their numbers. This dial, in connection with the scale Q_1 for the position of slide K_1, gives all the information needed for locating the proper position, amount and direction (whether to the right or to the left) for the first bend on each of the cam levers.

The Final Bending and Inspection Fixture

It was stated that two or three of the cam levers had three bends. These secondary bends are made in special dies, which need not be here described, as they are not used for all the levers. The final bend, however, given by the fixture shown in Fig. 8, is used on each one of the different cam levers. This final bending fixture is used both for bending and for inspecting. Its principle will best be understood by comparing it with the lay-out of the cam levers at E in Fig. 1. It will be seen that the studs at the upper ends of these levers form an arc of a circle. The final bends must then bring the upper ends of all the levers to this arc. In Fig. 8, this arc is represented by a circular tongue R_1, which has

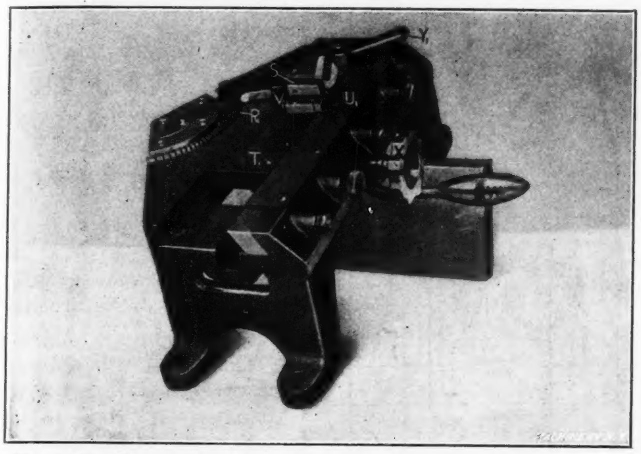

Fig. 8. Bending and Inspection Die for Final Operation on Cam Levers

slots in it corresponding to the proper positions for the studs on the different cam levers, these studs having been riveted in place just before the final bend.

The lever, as it comes to this fixture, is clamped in jaws S_1 on slide T_1, which latter is located by means of scale U_1 to a position accurately corresponding to its position to the right or left of the center in Fig. 1. This slide T_1 carries a pivoted bending stud with a slot, shown at V_1, and connected with handle W_1. This operates in identically the same fashion as does handle O_1 and pivoted jaw N_1 in Fig. 7. No positive stops are used to limit the motion of the handle, however; the workman simply bends the lever enough so that the stud

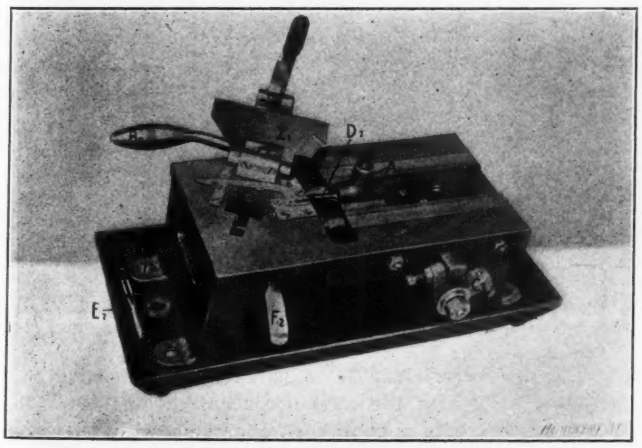

Fig. 9. Miniature Shaper for Rounding Edges of Type-bar Slots

accurately matches with the slot marked with the number of the work in the circular index R_1. Slide T_1 is adjusted by a rack and pinion movement operated by scalloped knob X_1. It is provided with clamping gib screws as shown. The jaws for holding the work (which is located by a gage-pin in the pivot hole) are operated by cam lever Y_1.

This bending and inspection fixture, it will be seen, holds the work in exactly the relative position it occupies in the finished typewriter, and bends its upper end to exactly the position it must occupy in the finished machine. For this reason it is correct to call it an inspection fixture as well as a bending fixture.

A Hand-operated Shaper

The tool shown in Fig. 9 is not used on the cam levers, but on the type-bars. It is here shown as a matter of general interest in the line of special toolmaking. It is, in effect, a hand-operated bench shaper. In Fig. 2 it will be seen that the slot at the lower end of the type-bar H is engaged by stud G in cam lever E. Now the pivots J of type-bars H at the extreme outer sides of the basket approach the horizontal, so that the action between G and the slot in H is not direct, but has a slight rolling effect. On this account the edges of the slot have to be slightly rounded to give easy action. This little bench shaper is used for the operation of rounding the edges of these slots.

The work H is located by the gage-plates shown, and is clamped in place by the cam lever hinge plate Z_1. The ram A_2 of the shaper is operated by handle B_2, and its motion is limited by the adjustable screw stops at C_2. The tool at D_2 is held in the ram by the set-screw shown. It cuts on its end, and is formed to give the correct rounding to the edges of the slot. Two cuts are taken, all the type-bars being given a roughing cut with the tool shown, and then a finishing cut with the second tool lying in the base of the machine at E_2. The lever at F_2 operates the knock-out for pushing the work from the gage-plates.

We would commend these dies and fixtures, particularly those shown in Figs. 3 to 8, as worthy of the study of any tool-maker whose work requires the design of multiple-purpose punch and bending tools.

* * *

BUILDING FOR THE FUTURE

Many of the manufacturing plants erected forty or fifty years ago were laid out without taking into consideration the possibility of growth, the result being that to add to an old plant often means re-construction and re-arrangement very costly to carry out. On the other hand, it is a not uncommon mistake to build nowadays with a large future in view, the result being that the business is handicapped for many years with heavy interest charges and an inefficient layout, because the conditions for efficient operation lie in the future. Mr. Henry G. Brinckerhoff, in a paper "Natural and Artificial Draft," read before the September meeting of the National Association of Cotton Manufacturers, touched on this phase of plant construction in discussing power plant and chimney construction, as follows:

"If you must add something [to the chimney] for "good luck" put it onto the height, as you stand to lose less on this, as excess [cross section] area will only come useful in a long distant future when the plant has grown to it. I have seen too many plants handicapped by strained proportions for a great future, whereas when the future did arrive, it was entirely a different mill or a problem altogether dissimilar to any initial conception. In following the mill development for twenty years here in New England, it has inclined me to believe that if I had the making of any new power plant layout, it would be my purpose to plan for the highest economy for the immediate needs, not extending farther perhaps than the next five years. This burdening a new plant to struggle under heavy fixed charges and loss in operating until the work develops to meet the initial undue proportion, is as bad as buying a man's suit for a boy because you know he is going to grow to it some day. Make things of right proportions to get the best economy for what you need now, and then success brings ample capital and you can then easier afford to throw away the old plant, if you like, and start out with another up-to-date outfit. In our conceit at any present time, we lay out big schemes for additional future boilers of the same kind in a great shed of a building and what do you generally find ten or fifteen years later but a collection of big and little units, different makes, different piping systems, etc., with the same thing seen in the engine room and elsewhere."

* * *

A common practice of French mechanics, when adjusting the crankshaft and connecting-rod bearings of automobile engines, is to chalk the bearings all over freely and then adjust the boxes until they "pinch" lightly. The chalk works out with a few revolutions and the space left provides sufficient clearance for running without heat, being just about the right amount for oil, but not so much as to cause pounding at high speed.

MAKING LOCKING BOLT BLOCKS AND SPINDLE CARRIER FOR GRIDLEY TURRET LATHE

By F. R. HUMPHREY*

An illustrated description of the machining operations on the spindle head of the Gridley automatic turret lathe was contained in the November, 1908, issue of MACHINERY. In this description most of the important operations on the spindle head were treated in detail, but the making of the locking bolt blocks was not dealt with at that time, and will, therefore, be described in the following.

As may be remembered from the original description of the Gridley automatic turret lathes, contained in the February,

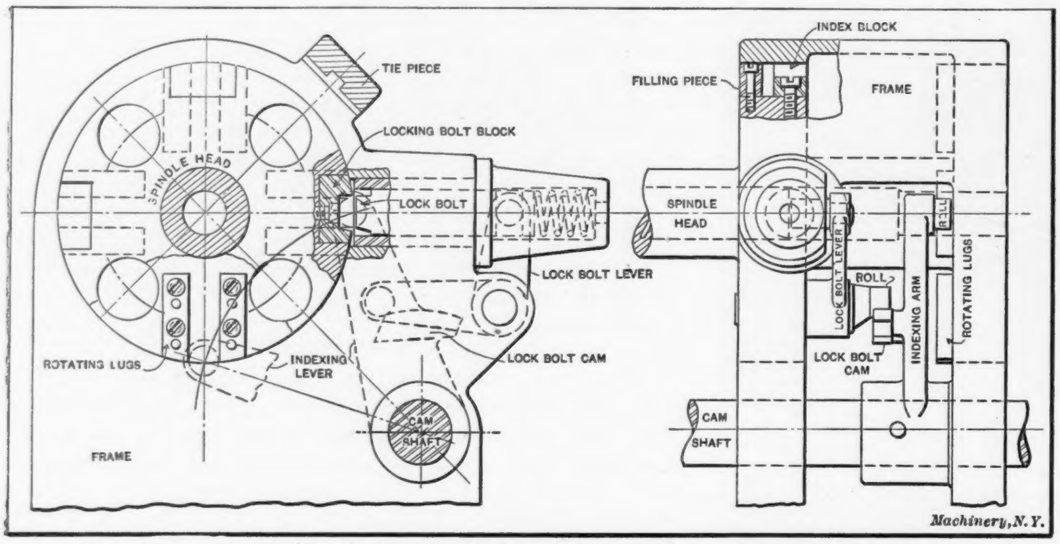

Fig. 1. General Design of Spindle Head and Indexing and Locking Mechanism of the Gridley Automatic Turret Lathe

1908, issue of MACHINERY, and also from the article in the November, 1908, issue, the salient feature of the machine is the construction of the spindle head, a general assembly view of which is shown in Fig. 1. The most vital point in the making of the spindle head is to provide for accurate alignment of the tools in the tool holder with the spindles. To accomplish this, it is also highly important that the locking mechanism for the spindle head make it possible to obtain exact and accurate indexing. As was mentioned in the previous article, if the indexing ring of the turret in a single-spindle machine was not exactly divided, the machine could still be made to do its work accurately, because the holes in the

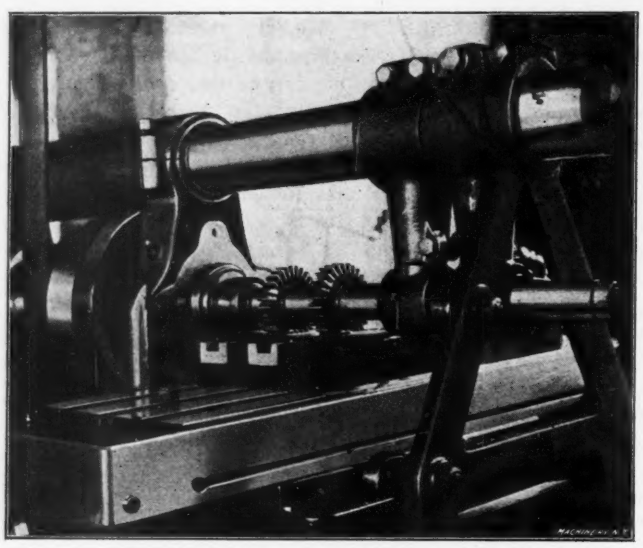

Fig 2. Fixture for Milling the Grooves in the Locking Bolt Blocks

turret would be bored to line up exactly with the spindle in each position. In a multiple-spindle machine, however, if the spindle head is not exactly divided, accurate work is impossible, because there will be no coincidence between the tools and the work in the different positions. The machining of the spindle head and all its details, including the locking mechanism and locking bolt block, therefore, is of extreme importance.

The locking bolt blocks for the spindle head (see Fig. 1) are made of tool steel planed from bars $2\frac{1}{2}$ inches wide and $1\frac{1}{4}$ inch thick, the bars being about 30 inches long. From the planer the bars are taken to the milling machine, where they are put into a fixture in pairs as shown in Fig. 2, and rough milled. This milling leaves the inside surfaces of the slots straight. A finishing cut is then taken in the same milling fixture, one side of the groove being beveled in this finishing operation.

After having been milled, the bars are taken to the cutting-off room and are cut into pieces $1\frac{1}{4}$ inch long, these pieces forming the individual locking bolt blocks. These blocks are now taken to the drill press and drilled and counterbored for a one-half-inch round-head screw. The jig used for drilling the blocks is shown in the center of the group in Fig. 3. After being drilled and counterbored, the blocks are hardened.

The most important part of the machining—that of grinding—is now to be done. The blocks are held one at a time in a vise on a Pratt & Whitney vertical-spindle wet grinder, and the bottom of the blocks ground. Then the blocks are put in sets of eight into a fixture, the blocks being held by screws. The fixture itself is held by means of a magnetic chuck on a Brown & Sharpe surface grinder, and the ends of the blocks are ground square with the bottom face and

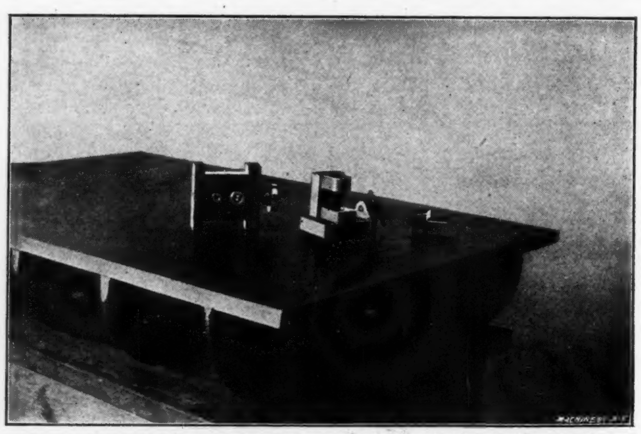

Fig. 3. Finished Locking Bolt Block, and Jigs used in Drilling Holes in Block and Spindle Head

brought to the correct length. A narrow-faced wheel is used for this operation. In the next operation the inside of the groove is ground with a cup-wheel, Fig. 4 showing the piece held at an angle for grinding the tapered side. After the grinding the blocks are ready to be put into the spindle head or carrier. The finished block is shown to the right in the group in Fig. 3.

The spindle carriers are made from cast iron. They are chucked, bored and turned in an engine lathe, and from the lathe they are taken to the radial drill and the spindle holes roughed out by the aid of a pair of plate jigs. After this operation, the spindle carrier is taken to the grinder and the outside cylindrical surface ground. The spindle carrier is now ready for the milling machine.

In Fig. 5 is shown the spindle carrier held in a milling fixture, a roughing cut being taken to provide a groove for the locking bolt blocks. The index disk on the milling machine is made of the greatest diameter which the machine will accommodate in order to eliminate errors in indexing as much

* Address: Windsor Machine Company, Windsor, Vermont.

as possible. To accomplish this, two plates were made and the index holes, drilled and taper reamed together. By moving the top disk one division, the total error was divided by four. Then the disks were taper reamed again. By repeat-

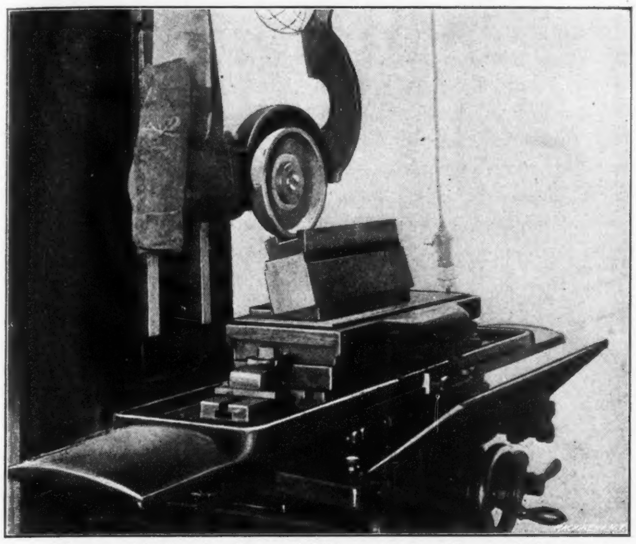
Fig. 4. Grinding the Tapered Side of the Locking Bolt Blocks

ing these operations the error was reduced until it could not be detected.

After the slots have been finish milled, the spindle carriers are taken to the radial drill and the screw holes for the blocks are drilled and tapped. The jig for this operation is

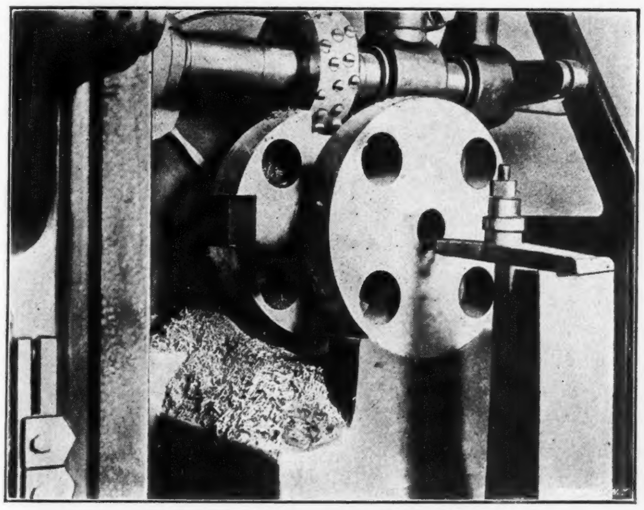
Fig. 5. Rough Milling the Spindle Carrier

shown to the left in the group in Fig. 3. The blocks are now put in place and tested with an indicator for any possible error in spacing which may have developed during the machining. The indicator is shown in position on the spindle

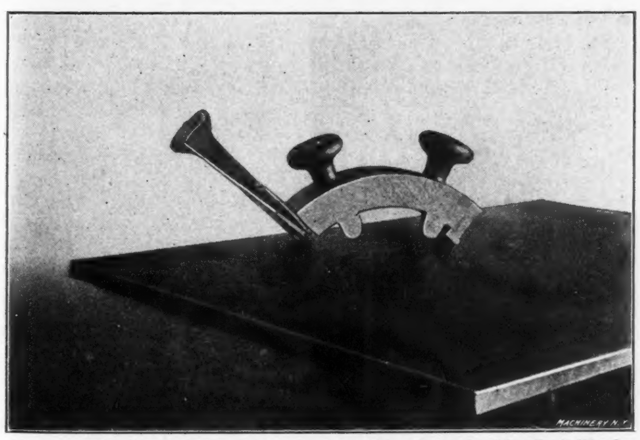
Fig. 6. Indicator for Inspecting the Location of the Locking Bolt Blocks

carrier in Fig. 7, the tool itself being shown in Fig. 6. The body of the indicator is made of cast iron, the handles being made of wood to prevent any expansion caused by the heat transmitted by the workman's hands. The needle is similar to that used on the Starrett indicator. The ratio is 0.001 inch to 1/16 inch and the scale is movable so that the readings can always be taken from the center.

If any error in the spacing of the blocks is indicated by this tool, the blocks are removed and the errors are marked on the bottom of each block with copperas. Small errors are removed by stoning, and for the correction of greater errors the blocks are sent to be ground. When the blocks are corrected the spindle carrier is ready for the last operation—that of finish boring the spindle holes. In Fig. 8 is shown a spindle carrier placed in the boring jig. This jig is made very rigid and the greatest care was exercised in machining it. The spindle holes are bored in the same relation to the blocks

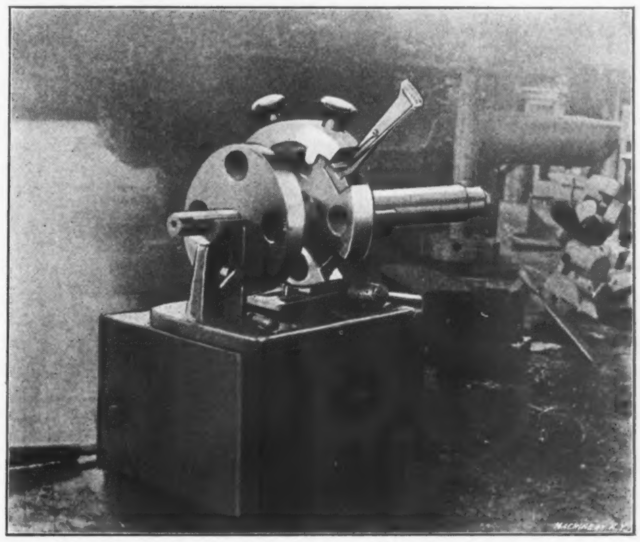
Fig. 7. Inspecting the Location of the Locking Bolt Blocks

as they will be, when in place in the machine. When the spindle holes are finished, the bushings are put in place and the spindle carrier is ready to be assembled on the machine.

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The articulated locomotive is generally supposed to be of comparatively recent origin; this conception, however, is erroneous. In an article in the *Railway Age Gazette*, the history of the articulated locomotive is reviewed, and it is of

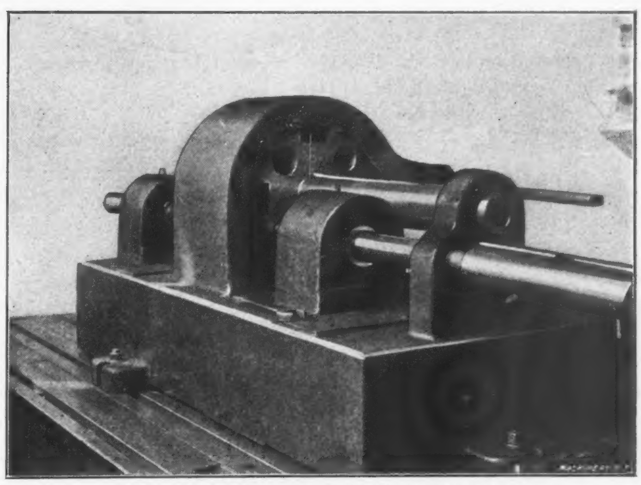
Fig. 8. Finish Boring the Spindle Carrier Holes

interest to note that the first type of articulated locomotive was built as early as 1831 at the West Point Foundry, from designs of Horatio Allen for the South Carolina Railroad. At the end of 1833 four of these locomotives were in use on that road. In 1850 an articulated locomotive was built at Neustadt, Austria, but it is stated that this engine soon proved a failure. As early as 1873, however, a type of articulated locomotive was built at Brussels for the Central Railway of Belgium, which, in some respects, had the appearance of a modern articulated locomotive. This locomotive was of the Meyer's system. The first Mallet articulated compound locomotive was built in 1888, and the first locomotive of this type, in America, was built at the Baldwin Locomotive Works in 1904.

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MACHINERY

DESIGN—CONSTRUCTION—OPERATION

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We solicit exclusive contributions from practical men on subjects pertaining to machine shop practice and machine design. All accepted matter is paid for at our regular space rates unless other terms are agreed on.

NOVEMBER, 1910

PAID CIRCULATION FOR OCTOBER, 1910, 26,154 COPIES

MACHINERY is published in four editions. The practical work of the shop is thoroughly covered in the Shop Edition, $1.00 a year, which comprises approximately 700 reading pages and 36 Shop Operation Sheets, containing step-by-step illustrated directions for performing 36 different shop operations. The Engineering Edition—$2.00 a year, coated paper $2.50—contains all the matter in the Shop Edition, including Shop Operation Sheets, about 300 pages a year of additional matter and forty-eight 6 x 9 Data Sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, $3.00 a year, comprises the same matter as the Engineering. The Railway Edition, $2.00 a year, is a special edition including a variety of matter for railway shop work—same size as Engineering and same number of Data Sheets.

THE DEADLY SET-SCREW

Statistics show that about five hundred thousand persons are killed and injured every year in industrial occupations, including railroads and mines, in the United States. In manufacturing establishments the innocent-looking set screw on pulleys, gears and other revolving parts, is the cause of a considerable percentage of the maiming and killing. If we put it at only one per cent, which is undoubtedly low, the casualties for the last twenty years directly attributable to this one bad feature of machine construction alone would exceed those of the bloodiest battle in the Civil War. Is not that too great a price to pay for a means of securing pulleys to shafts?

We seldom make a proprietary article the subject of an editorial, but where the use of an improved mechanical device means the saving of life and limb it is a duty and a pleasure to advocate it; and this is the case with the hollow flush head set-screw put on the market a few years ago and now available in improved form. This appliance should solve the set-screw problem, for it is neat, effective, durable, easily applied and, best of all, perfectly safe. The stringent labor laws recently passed in New York, New Jersey and other states make it imperative to protect machinery effectively at all danger points, and if all safety devices were as cheap and as easily applied, the path of the reformer of dangerous machinery construction would be much easier.

* * *

THE DEVELOPMENT OF SPECIAL MACHINERY

When it is found necessary to deviate from the beaten path in designing machinery, experimenting is always necessary. Some, not familiar with this subject, have the idea that one who has spent a number of years in designing special machinery should be so practical and expert in his line that experimental work would not be necessary to perfect his plans. These are mistaken ideas which will be quickly dispelled if the person having such views will visit one of our large manufacturing concerns and see how special machinery is developed. With these large manufacturing concerns the practice is to show on paper only general sketches of what is wanted. Then these sketches are turned over in the rough, to experts, who develop the idea into a satisfactory working machine. It sometimes requires months and years to get the degree of perfection required, and in certain cases the first plan is entirely discarded. If it were possible for a machinery designer to conceive an idea and work it out to satisfaction on paper, it would not be necessary for these large firms to maintain experimental departments, but as it is practically impossible for any designer to anticipate all the requirements of new machines, even though essentially simple, this department has been found necessary, and certainly is one of the most important of most large machinery manufacturing concerns. The need of experimental work, of course, applies to special machinery where definite data and information on the subject are lacking, and something new is being evolved.

* * *

LEARNING BY EXPERIENCE

A good workman will sometimes make a blunder, the exposure of which may cause him a great deal of unnecessary trouble or even hardship. If he is of the right sort the mere fact that he has blundered is punishment enough, and no second experience is necessary to teach him a lesson. A "trouble man," working for almost any machine tool builder or machine manufacturer has many opportunities to put men of all degrees from the machine operator to the superintendent "in the hole, bad," but most of them never tell the employers the whole truth about reported troubles. They feel that the chagrin of an employe at his own lack of perception is sufficient, and that he generally profits by the experience.

Some years ago a well-known machine tool builder sold a boring machine to a large concern, and soon received a report that the machine was working badly. The report of the trouble was vague and a personal visit was necessary, which was made by the manager. Investigation showed that the machine spindle *was running backward.* Simply twisting the driving belt stopped all trouble. The foreman stood in fear and trembling for his reputation with his employer, and timidly asked the manager what he was going to say about the cause of the trouble. The manager assured the foreman that his statement of the cause of the trouble would be so diplomatically worded as to cast no discredit—and it was. The manager paid his own carfare and smoked his own cigars, but everyone was pleased and happy. The manager's view was that though the foreman ought to be discharged, *his* company did not want any of the blame.

* * *

EDUCATION OF MUSCLES AND MIND

Enthusiastic educators who realize the great need of industrial education fully understand the important influence of well-trained muscles in making well-trained brains. Mr. Edward Rumely, a Western manufacturer, deeply interested in balanced training of mind and body, says:

> The training of manual work, the keen discipline in learning any one of the skilled trades, is the schooling that is needed above all by the city boy; but all boys need it, not only because it goes to make efficient men of them, but because it is a necessity to their bodies. * * * Few realize how much muscle means to the brain, yet the brain is taught by the muscle as well as by the nerves of the ear and eye. Fully ninety per cent of our life is guided by muscular sensation. The baby depends upon it almost wholly for a long period of its early life. Its first education is a physical education—an education of the muscles. Its development and training through life and experience is a type of later education that is practical through its muscle, above all by its hands, in drinking in knowledge of the outside world. * * * We see iron, its crystals, its luster, but we must bend and break it, weld and hammer it, file and test it, and put it to mechanical uses with our hands before we can know much of that metal which has become the main carrier of our civilization.

A skilled mechanic, whose mind has been trained to think logically and to apply the forces of nature to the best advantage, is invincible and indispensable. He is worth many times more than the Greek professor with untrained hands and a mind filled with knowledge of the hoary antiquities of a dead past. An enlightened educational system that will train the mind through the muscles as well as fill it with useful information is one of the great improvements in our institutions that is rapidly developing, and its meaning is that the man who works will reap more benefit from what he produces.

Supplement to MACHINERY, November, 1910

Operations for the *Article* in this number entitled "Machine Shop Practice—Setting up Work for Boring on the Milling Machine"

SHOP OPERATION SHEET NO. 151

John Edgar — MACHINERY, November, 1910

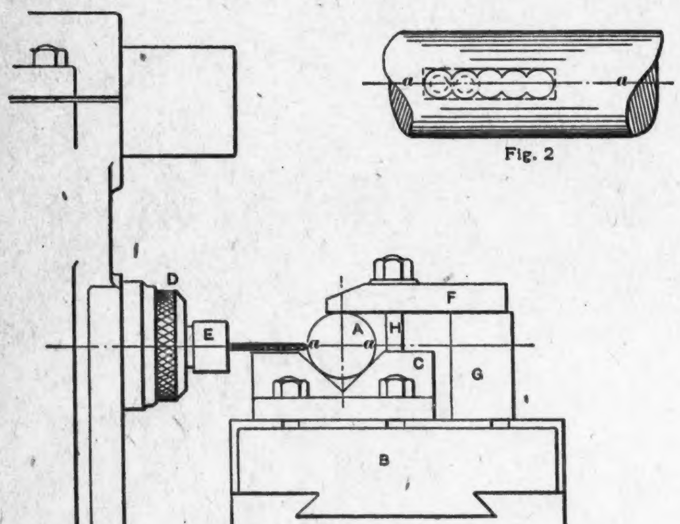


Fig. 2

Fig. 1 *Machinery,N.Y.*

To Drill and Counterbore a Bar or Shaft for Slotting

NOTE.—The slot is to extend entirely through the bar, and is supposed to have been previously laid out as shown in Fig. 2.

1. Select the following tools, *viz:* A counterbore six or eight thousandths smaller than the width of the proposed slot with a pilot about half that diameter; a twist drill of same diameter as pilot of counterbore; a spotting drill carefully ground, and a suitable chuck for holding these tools.
2. On the milling machine table *B* bolt two V-blocks *C*, far enough apart to leave ample space for working, but close enough to support the bar firmly.
3. Place in the main spindle *D* the drill holder *E*, with the spotting drill set to run true. Lay the shaft or bar *A*, to be slotted, into the V-blocks with the center line *a—a*, Fig. 2, toward the spotting drill, and the center line *a—a*, Fig. 1, exactly horizontal, as shown by a surface gage. Clamp the bar by two straps *F* after having set it at right angles to the axis of the spindle. Test the truth of the setting by means of a swinging trammel placed in the spindle.
4. Set the table *B* so that the center line *a—a*, will be exactly at the height of the point of the spotting drill.
5. With the spotting drill, center a series of holes at such distance apart that when drilled, and the counterbore is used, it will not cut into the next small hole.
6. Replace the spotting drill with the twist drill, and bore the series of holes entirely through the bar *A*, the carriage being fed inward by hand.
7. Replace the twist drill with the counterbore, and counterbore the series of holes entirely through the bar *A*, again feeding by hand. The slot in the bar will now appear as shown in Fig. 2.

SHOP OPERATION SHEET NO. 152

John Edgar — MACHINERY, November, 1910

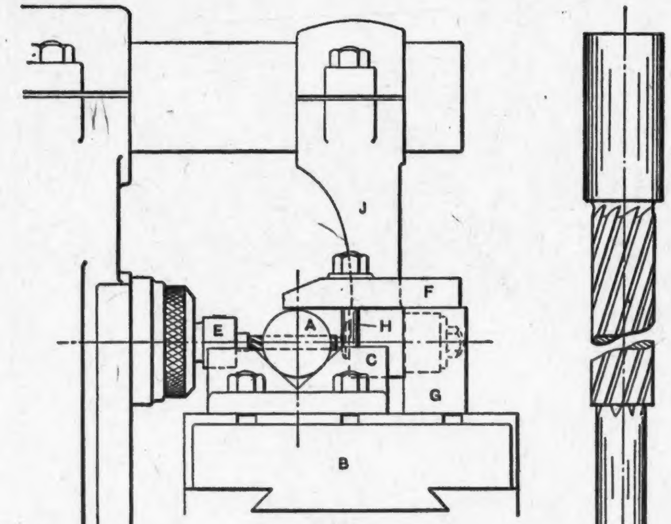


Fig. 1 *Machinery,N.Y.* Fig. 2

To Finish a Slot by Milling

NOTE.—The bar or shaft to be slotted is supposed to remain clamped down in the grooves of the V-blocks as located and held in the last operation.

1. Select or provide two milling cutters of the form shown in Fig. 2, one to be of a diameter equal to the finished width of the slot to be milled, and one from six to eight thousandths of an inch less in diameter.
2. Place the smaller of these milling cutters in the drill holder *E*, and bring the shaft *A* to the proper position to permit the milling cutter to pass through the end hole of the series that have been drilled and counterbored through it, as described in the previous operation. Bring up the outer supporting arm *J*, and adjust it to support the outer end of the milling cutter.
3. Start the machine at a proper speed, which will depend upon the diameter of the milling cutter and the quality of the material of the bar to be slotted, and using the hand feed, move the work along until the slot is milled nearly to the opposite end.
4. Replace the smaller milling cutter by the larger one, and feed the work in a direction parallel to the axis of the cutter until the cutter is through the slot. Then adjust the supporting arm *J* to its outer end, and repeat the milling operation as described in Step 3. The slot will now be the required width, and it should be finished to within about ten thousandths of an inch of the proper length.
5. Remove the outer support of the milling cutter, and take out the cutter. Let the shaft *A* remain clamped in the V-blocks as in this and the preceding operation, for squaring the ends of the slot as described on the next sheet.

SHOP OPERATION SHEET NO. 153

John Edgar — MACHINERY, November, 1910

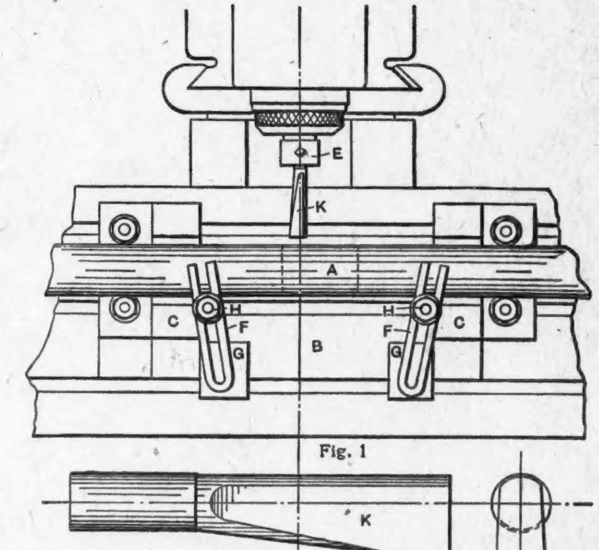


Fig. 1

Fig. 2 *Machinery,N.Y.*

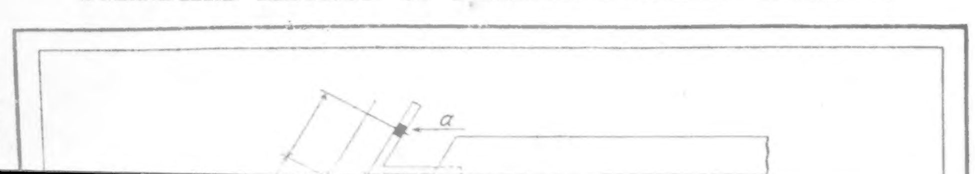
To Square the Ends of a Slot

NOTE.—The above engraving shows a plan view instead of an end elevation as in the two former operations.

1. Select or provide a slotting tool *K*, of the form shown in Fig. 2, the cutting edge *k* being of the exact width of the finished slot.
2. Throw the back gears of the main spindle of the machine into engagement. With the usual lock-nut, fix the driving cone and face gear to each other so as to prevent any rotary movement of the main spindle.
3. Place the slotting tool *K* in the drill holder *E*, with its cutting edge *k* set at right angles to the machine table *B*, testing the position with a square upon the top of the table.
4. By means of the cross-feed screw, work the carriage inward so that the slotting tool *K* passes through the slot. Work the table *B* alternately outward and inward in this manner, using the lateral feed screw of the table *B*, as a hand feed, and thus forcing the slotting cutter to take a light cut at each inward stroke until the circular end of the slot is squared up to the limit line.
5. After one end of the slot is finished release the slotting tool *K*, and turn it half way around so that its cutting edge *k* faces in the opposite direction. Again set the cutting edge *k* at right angles with the table, and clamp the tool in this position.
6. Square the opposite end of the slot as described in Step 4, finishing the slot to the required length. In doing this job, if it is kept in mind that one makes haste slowly on this class of work, the time required may be reduced to a minimum.

STANDARD METHOD OF DETAILING I-BEAM WORK—II

Contributed by



STANDARD METHOD OF DETAILING I-BEAM WORK—I

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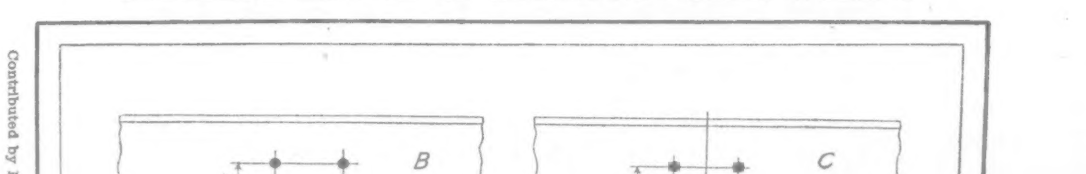
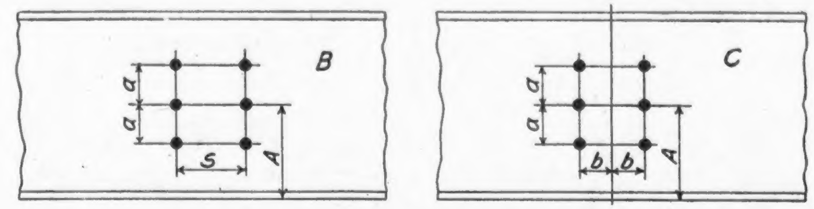
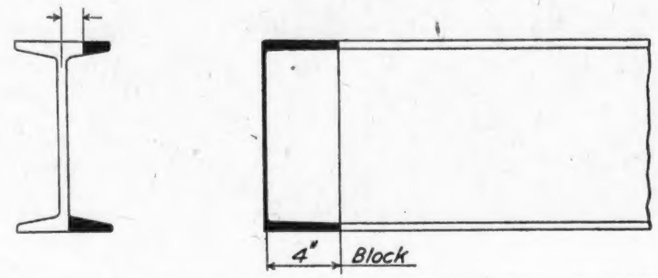


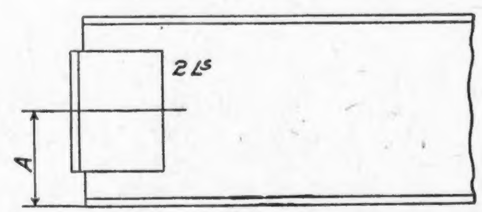
STANDARD METHOD OF DETAILING I-BEAM WORK—I



When showing web holes where another beam or channel connects to the one being detailed, give A from bottom of beam to center of connection. For a beam connection give S as shown at B. For a channel connection give b-b as shown at C. Do not give any dimensions for a-a, as this is always $2\frac{1}{2}''$ except for 18", 20" and 24" beams, which will be 3". Where there is a special connection always give A, b-b, and a-a. Always give vertical dimensions from bottom of beam or channel.



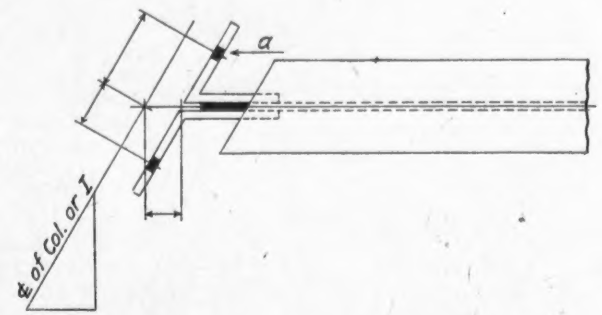
When flanges must be cut for clearance, detail same as shown above except for a bevel cut, for which a top or bottom view must be shown.



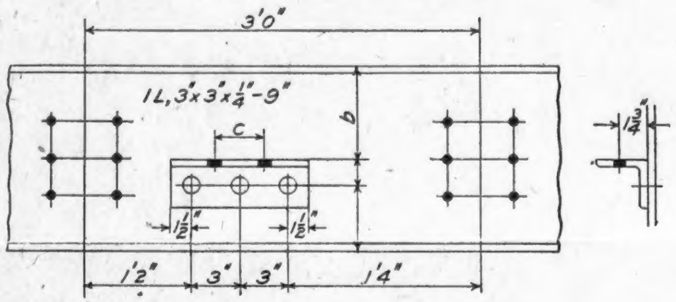
Do not show any rivets or open holes in standard clip angles. Always give A from bottom of beam to center of connection.

Contributed by Harry Gwinner

STANDARD METHOD OF DETAILING I-BEAM WORK—II



To obtain the dimensions required for the above detail, make lay out of 3" = 1'0" of the point in question. Make sure that a is located in a position that there may be no trouble to rivet same in field. Cut beam back from face of bent plates $\frac{1}{2}''$ as shown.

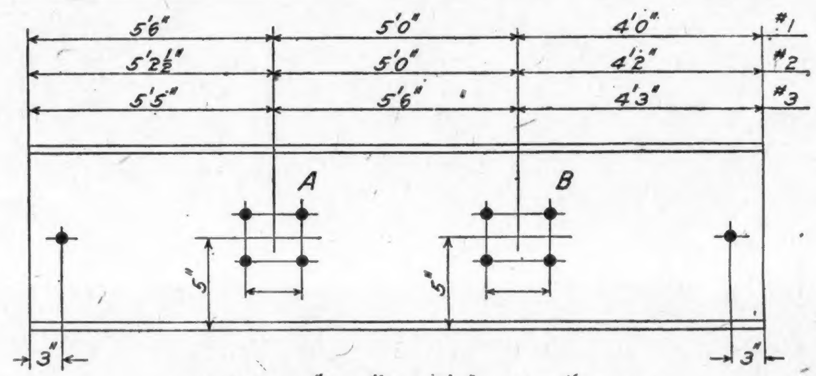


In case of a lug being riveted to the web of beam or channel, tie rivets with center line of nearest web connections. Give gage for open holes as shown. Dimension b is very important and should not be omitted. As shown in sketch, c is symmetrical with center rivet. When not symmetrical, tie with center rivet.

Note:- In detailing beams, make details as simple as possible for the shop. Do not give any figures or notes that will mislead the shop. Do not tie holes in flange with web holes. Do not use the word "omit".

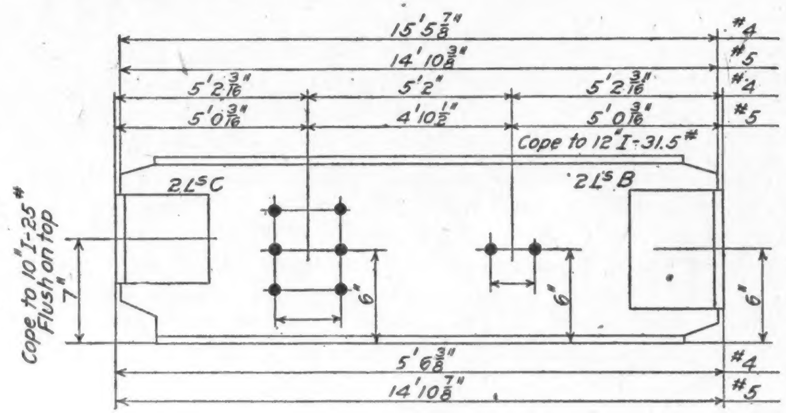
Contributed by Harry Gwinner

STANDARD METHOD OF DETAILING I-BEAM WORK—III



Make 2, 10"-25# Is 14'6" Mark #1
Make 1, 10"-25# I 14'4½" Mark #2
Make 1, 10"-25# I 15'2" Mark #3

The above shows beam having both ends wall bearing. At A is shown beam connection and at B channel connection. Always give figures for channel spacing as shown. It is understood that the two end holes are located in center.

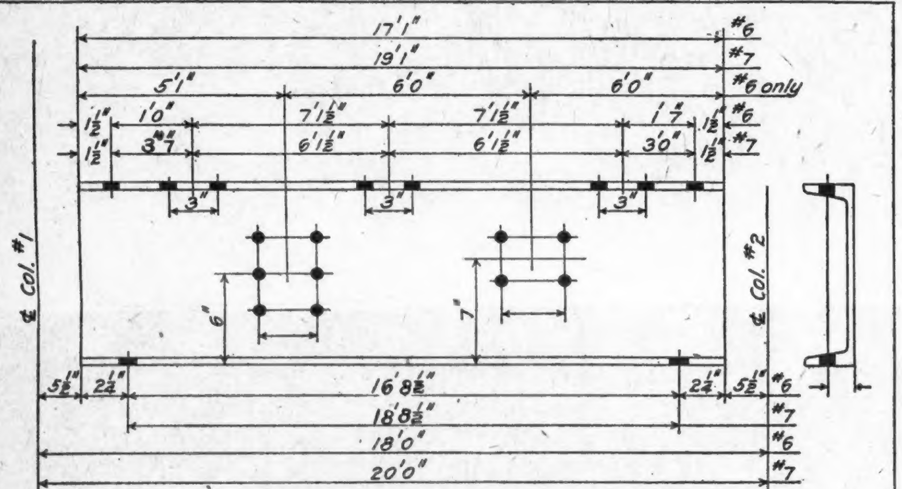


Make 2, 12" Is-31.5# 15'6⅜" Mark #4
Make 2, 12" Is-31.5# 14'10⅞" Mark #5

This sketch shows beam having coping at each end with standard clips, holes for tie rods and 12"I connection. Carry all dimension lines above beam except total length over end clips. Do not give any more dimensions than shown, for a beam of this kind. Do not show any rivets in standard clips.

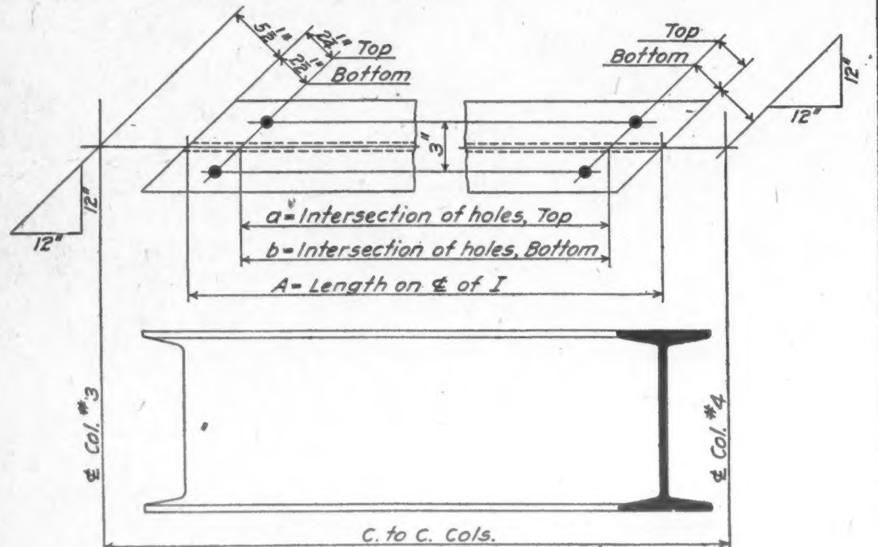
Contributed by Harry Gwinner

STANDARD METHOD OF DETAILING I-BEAM WORK—IV



Make 2-12" [20.5#-17'1" Mark #6 R as shown L opp. hand
Make 2-12" [20.5#=19'1" Mark #7

The above sketch shows a beam fitting between Columns. Always give the distance C. to C. of Cols., as shown. Also give the distance C. to C. of end holes in bottom flange below sketch of beam; all other dimensions above the sketch.



Make 1-12"I, 31.5#A Mark #8

Contributed by Harry Gwinner

CEMENT FLOORS IN MACHINE SHOPS

Probably there is no floor for machine shops and similar establishments as good as one made of selected hard maple, properly laid and supported. It is comfortable to work on, is free from dust, does not damage finished work dragged over it and, being somewhat elastic, a casting is not likely to break if dropped on it from a workman's hand. But the high cost of lumber and the fire risk, especially in screw machine departments, are against the wooden floors; and many modern plants have been built with cement or stone composition floors. These floors have a serious fault, being very uncomfortable for the workmen who have to stand all day. A reader in the Middle West writes as follows:

"Of late we have heard quite a good deal in our section against the adoption of cement floors in manufacturing establishments, and we know of some cases in our immediate vicinity where workmen have been crippled from standing on such floors, but in the face of this, we notice some of the recently constructed reinforced concrete buildings for industrial purposes are being built with this kind of flooring."

A cement floor has the same defect as stone, damp earth, iron and any material that is a good conductor of heat. It reduces the temperature of the workmen's feet and legs, which in susceptible subjects may set up serious derangements of circulation, resulting in rheumatism, sciatica or other painful troubles. If the cement floor is warmed, it will be found no more injurious than a wooden floor. The relative hardness of cement and wood is of no practical importance, being, if anything, in favor of cement. The greater solidity of foothold is in its favor for those who have to handle heavy materials. A springy floor is tiring, and contrary to the common opinion is not as easy to work on as a solid floor. That it is the lowering of the temperature of the extremities—cold feet—which causes the discomforts incident to cement floors, can be easily proved by laying boards in front of machines for the men to stand on. Although the boards rest directly on the cement and are practically inelastic the trouble complained of will disappear. We believe from the information received that it is necessary for the comfort and well-being of employes in establishments having concrete floors that the floors be either warmed in winter or covered with some heat non-conducting material where the workmen stand, such as boards, mats, etc. The workmen will find that cork-soled shoes will greatly promote their comfort if they must stand all day on the unprotected cement.

* * *

THE MACHINIST'S PROSPECTS

To say there are numerous opportunities for advancement in the mechanical field within the grasp of men in the works, is to make a statement likely to be received with skepticism by many. Nevertheless we make it, and the proof of its accuracy lies in the fact that almost invariably the machinist who devotes his spare time to study is advanced to positions of responsibility. This does not mean that success always follows study, nor that one can completely fit himself for a responsible position by reading and study at home or in school. Books give much that is essential, but cannot supply all. A man's personality, his character, his temperament, his judgment—all these are factors which determine the degree of his success; but without knowledge, these in themselves are insufficient. The foreman, draftsman or superintendent, each must possess the personal qualifications which fit him for his position. Nevertheless, the machinist whose ambition impels him to the reading and study of books and publications that explain the principles and practice of mechanics, usually is promoted; and this important fact deserves wider recognition than it receives, we think, among the young mechanics of the day. Many of our industries are still in their infancy, and innumerable enterprises are being developed, so that there will be a steady and ever-increasing demand for thoroughly competent foremen and superintendents; and these usually have been and almost always will be recruited chiefly among the men who have trained their minds as well as their hands, and are thoroughly familiar with the practical and theoretical problems which constantly arise in every works. The young machinist who intends to continue in mechanical work needs now, and will more urgently need in the future, all the book knowledge he can acquire. A correct understanding of the principles of mathematics—the ability, for instance, to utilize trigonometry with as much facility and as effectively as a hammer or other tool, means increased usefulness and efficiency.

But does the man who devotes his spare time to study usually receive any adequate recompense? This question can certainly be answered in the affirmative. We do not mean necessarily that the week after a man demonstrates his increased value to his employer, it will be recognized by an increase in wages; but it is true that there are many opportunities in the mechanical field for the machinist with some technical training, where there is hardly one for the man who is unable to use his head as well as his hands—to say nothing of the satisfaction that is derived just from *knowing*. Diligence is usually rewarded, and we are sure that any machinist who will devote even a half hour each day during the coming year to careful reading on mechanical subjects, or to study, will find that it pays.

* * *

NOTES ON STRUCTURAL STEEL DETAILING FOR MECHANICAL DRAFTSMEN

By HARRY GWINNER*

It is the intention of the writer to give some notes on the detailing of structural steel, with the hope that they may prove of aid to the young mechanical draftsmen who have not as yet gone into the subject. The subject of structural steel detailing is a growing one, and in the near future every draftsman will be expected to have some knowledge of it.

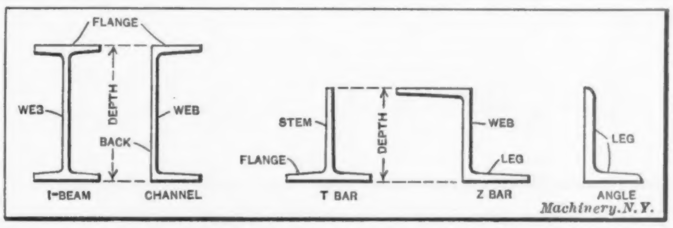


Fig 1. Standard Shapes of Beams and their Names

By structural shapes are meant those shapes, in steel, which generally enter into construction work. Some of the standard shapes and their names are given in Fig. 1, and are designated as follows: I (Eye) Beam—Designation 12" I, 31.5#, means 12 inches deep, and weight per foot = 31.5 pounds. Channel—Designation 15" [33#, means 15 inches deep, and weight per foot = 33 pounds. T (Tee) Bar—Designation 3" x 3" x 6.8# T, means flange is 3 inches wide, stem is 3 inches deep and weight per foot is 6.8 pounds. Z (Zee) Bar—Designation 6" x ½" x ¾" Z means depth is 6 inches, flanges 3½ inches; and ¾ inch is the thickness of web and legs. Angle—Designation 4" x 3½" x ½", means one leg is 4 inches deep or wide, the other is 3½ inches wide, and the thickness of each is ½ inch.

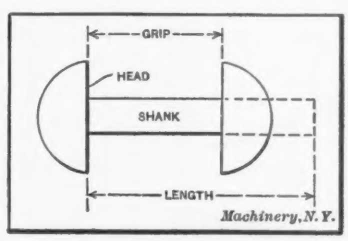


Fig. 2. Showing the Grip of a Button Head Rivet

These and a few other shapes with their properties or elements are given in the handbooks issued by the Cambria Steel Co., Carnegie Steel Co., Jones & Laughlin, Passaic Steel Co., and the Phoenix Iron Co., as well as the new book issued by the Bethlehem Steel Co. Some of these books are gratis while the others cost about one dollar each.

Rivets

The grip of a rivet, as shown in Fig. 2, is equal to the sum of the thicknesses of the pieces it is to join; but an additional amount, about 1/32 inch more for each piece, should be added to make allowance for the roughness of surfaces in contact.

* Dean of Mechanical Engineering and Superintendent of Shops, Maryland Agricultural College, College Park, Md.

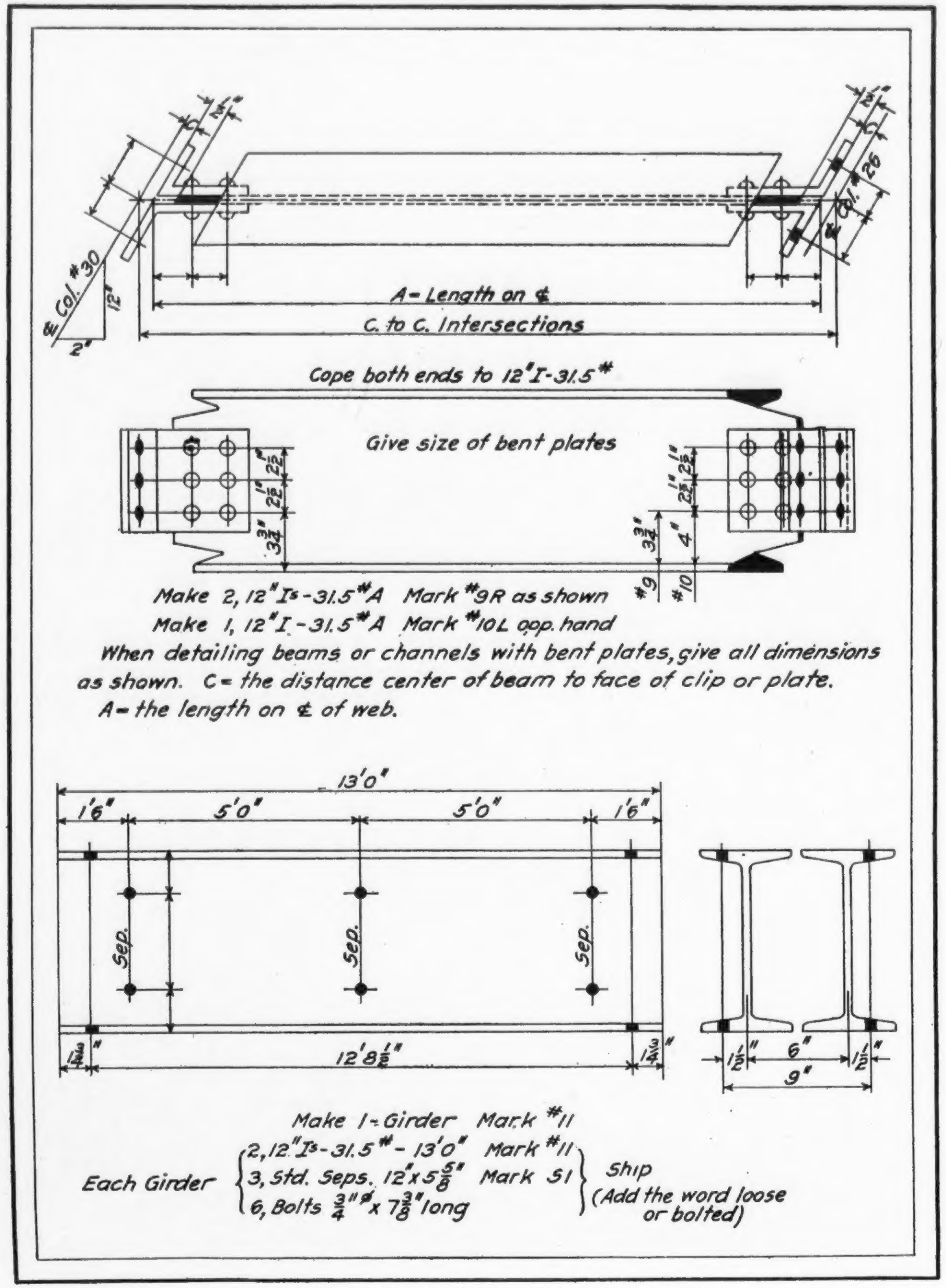


Fig. 3. Method of Detailing I-beam Work

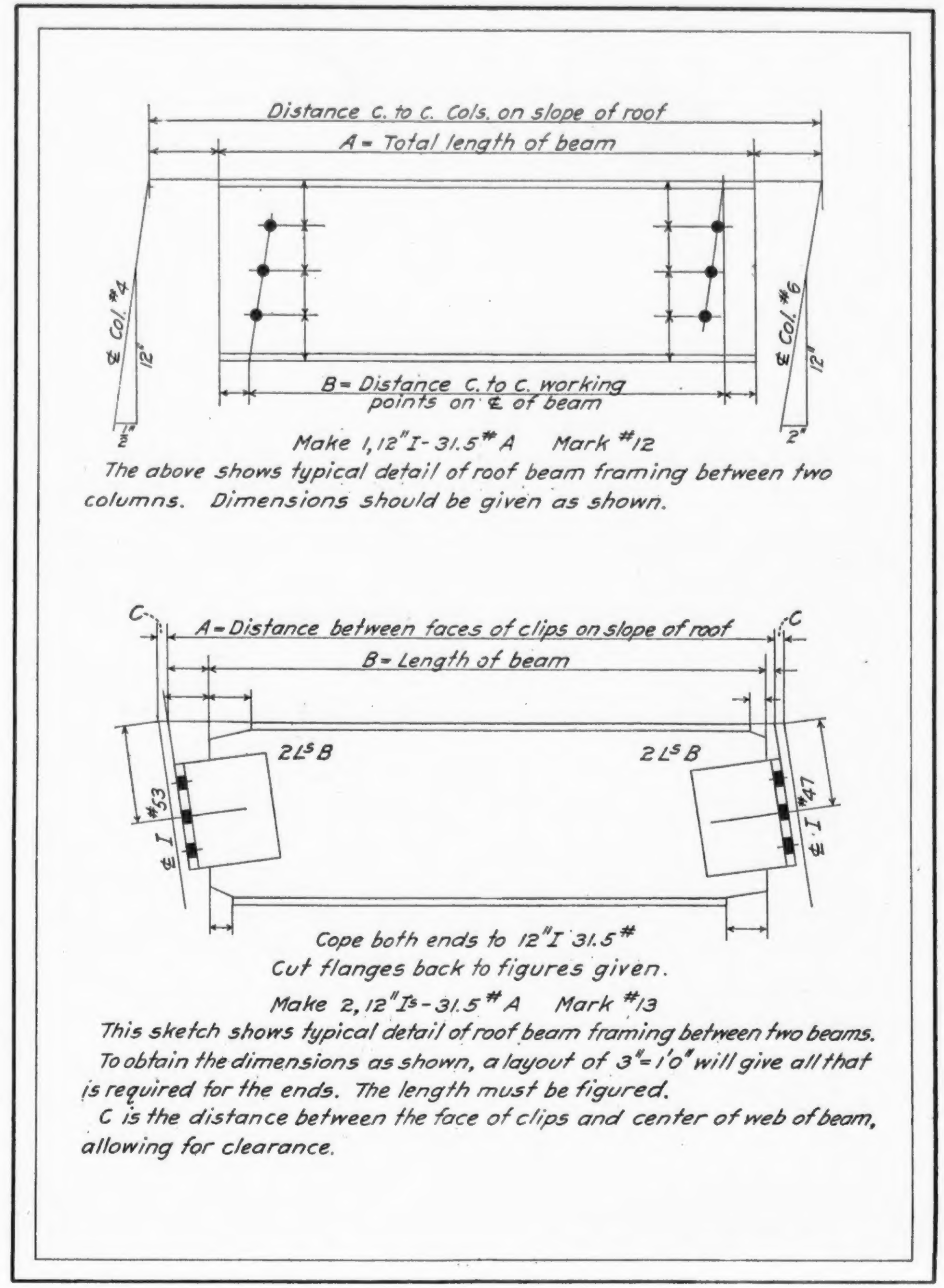


Fig. 4. Method of Detailing Roof Beam Framing

The lengths for different grips to form the additional head, as well as the shearing and bearing values of rivets, are given in the above-named handbooks. By bearing, or bearing resistance, is meant the resistance of the rivet hole against elongation or crippling of the plate, causing it to buckle under the rivet head or crushing the rivet; it depends upon the safe unit compression stress and involves what is called the bearing area. The bearing value is then the product of the thickness of the plate, diameter of rivet and the safe unit compression stress as shown by the tables in the handbooks mentioned, under the heading of "Bearing Values of Rivets."

In testing or designing the joint for shearing and bearing, divide the total stress to be transmitted, by the smaller value,

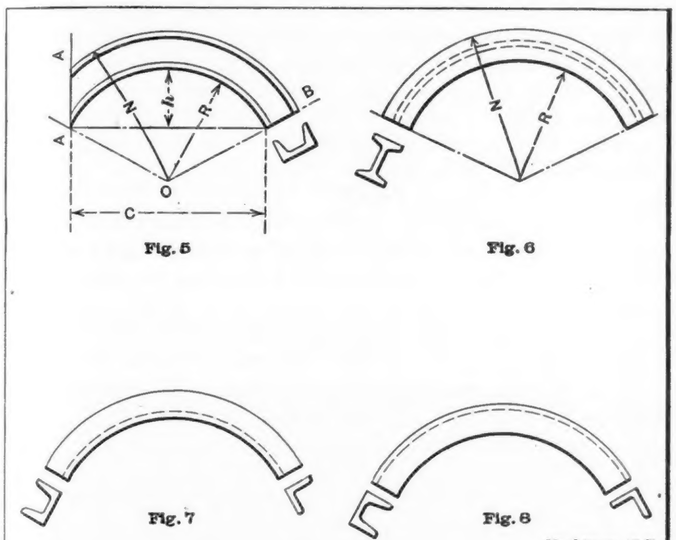


Fig. 5 Fig. 6 Fig. 7 Fig. 8

Figs. 5 to 8. Methods of showing Curved Sections of Channels, I-beams, and Angles

to ascertain the number of rivets required. The handbooks give the allowable pitch for the different size rivets.

In compression members, the material cut away for the rivet holes is made good by the rivet filling the hole and resisting the squeezing of the metal on the sides bearing on the rivet; but such is not the case for tension members, as the amount of material cut away for the rivet hole is not made good, the stress being away from the hole on each side. It is important, therefore, to investigate the net section of tension members along the line of the rivet holes to see if there is sufficient metal in the net section to transmit the stress. In order to do this, it is necessary to determine whether one or more holes are to be deducted in ascertaining the net area. In the Data Sheets accompanying the article on "The Design of a Plate Girder" in the April, 1910, number of MACHINERY, engineering edition, are tables giving the net area after deducting one and two holes.

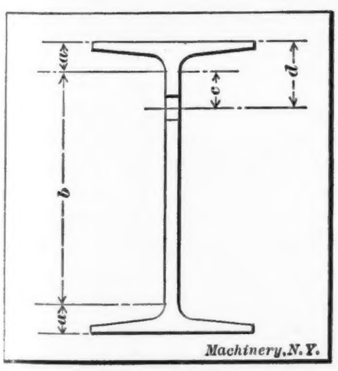


Fig. 9. Method of Spacing Rivet Holes to prevent Plates from encroaching on the Fillets and Slopes of Sections

Clearances for Rivets

The diameter of the rivet head is equal to 1½ times the diameters of the shank plus ⅛ inch; the depth or height of the head is equal to 0.6 of the diameter of shank and the radius of the head equals ¾ of the diameter of the shank.

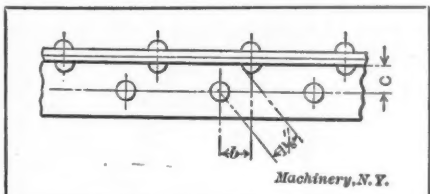
In general, in calculating for clearance for rivet heads, allow ⅝ inch for height of ¾-inch rivet heads, and ¾ inch for ⅞-inch rivet heads; also allow ⅜ inch clearance between the edge of the rivet head and any adjacent surface, to provide clearance for the heading tool. For ¾-inch and ⅞-inch rivets, allow if possible, 1¼ inch from the center of the rivet to the back of an adjacent surface at right angles.

Table I gives the clearances for the spacing of rivets and shows an angle section with one row of holes in one leg. The minimum spacing or staggering for two lines of rivets in one leg is given in the handbook issued by the Bethlehem Steel Co., page 258.

Beams

The four Data Sheets accompanying this article, and also Figs. 3 to 8 inclusive, give the method of detailing beams adopted by one concern which does a large amount of bridge and building work, and are very complete. They illustrate good practice and serve as excellent examples of beam detailing for rapid execution in the shop and checking in the drafting-room.

TABLE I. CLEARANCE BETWEEN RIVET HEADS FOR ANGLE SECTION HAVING ONE ROW OF HOLES IN ONE LEG

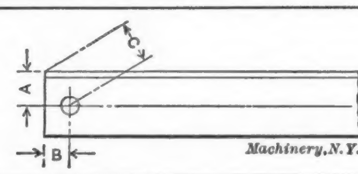


c	¾-inch Diam. b	⅞-inch Diam. b
1 1/8	1 1/4	1 3/8
1 3/16	1 3/16	1 5/16
1 1/4	1 1/8	1 1/4
1 5/16	1 1/16	1 3/16
1 3/8	15/16	1 1/8
1 7/16	7/8	1
1 1/2	3/4	15/16
1 9/16	5/8	13/16
1 5/8	3/8	11/16
1 11/16	0	1/2
1 3/4	0	5/16

Figs. 5 to 8 inclusive show methods of detailing curved sections of channels, I-beams and angles. When detailing the above sections the following method should be used: Give the length *C* and either *N* or *R*, and also state whether the ends are to be cut square to the chord, as to the line *A-A*, or whether they are to be cut radial, as to the line *O-B*. It should also be stated whether the web of the beam should be in a horizontal plane as shown in Fig. 5, or in a vertical plane as in Fig. 6.

In the case of channels or angles, state whether the web or leg is to be on the inside as shown in Fig. 7, or on the outside as shown in Fig. 8; and in the case of unequal leg angles, state which leg is to be vertical to the curve.

TABLE II. DISTANCE C FOR VARIOUS GAGES AND END DISTANCES



Gage A	End Distance B			
	1⅛-inch	1¼-inch	1½-inch	1¾-inch
3/4	1 3/8	1 1/2	1 11/16	1 15/16
7/8	1 7/16	1 9/16	1 3/4	2
1	1 1/2	1 5/8	1 13/16	2 1/16
1 1/8	1 5/8	1 11/16	1 7/8	2 1/8
1 1/4	1 11/16	1 13/16	1 15/16	2 3/16
1 3/8	1 13/16	1 7/8	2 1/16	2 1/4
1 1/2	1 7/8	2	2 1/8	2 5/16
1 3/4	2 1/8	2 3/16	2 5/16	2 1/2
2	2 5/16	2 3/8	2 1/2	2 11/16
2 1/4	2 9/16	2 9/16	2 3/4	2 7/8
2 1/2	2 3/4	2 13/16	2 15/16	3 1/16
3	3 1/4	3 1/4	3 3/8	3 1/2

The splicing of beams has already been excellently handled in the November, 1909, issue of MACHINERY.

It will not be amiss to call the reader's attention to the following points relative to all sections, as the writer has seen work rejected by inspectors more than once because plates and rivets have encroached on the fillets and slopes of sections. Observe notes relative to this typical section, as shown in Fig. 9.

The dimensions *a* and *b* are given in the handbooks—the distance *b* should not be exceeded in using splice plates, as the

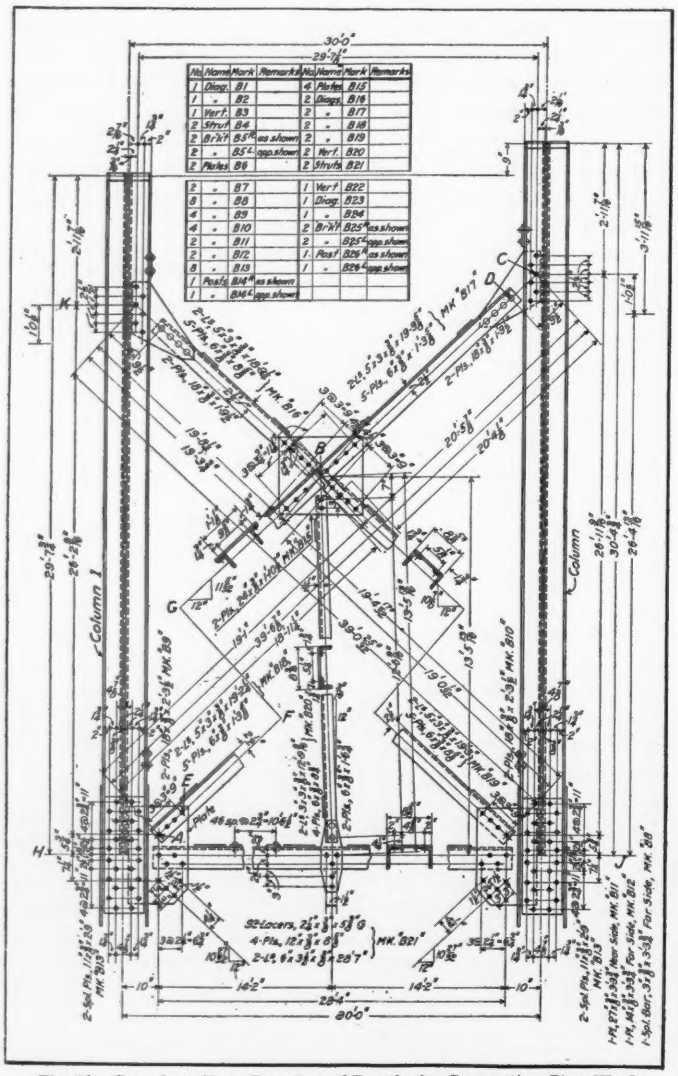


Fig. 10. Complete Shop Drawing of Trestle for Supporting Pipe Work

Assembled Details

In Fig. 10 is a complete shop drawing of a portion of a bent or trestle for supporting some heavy pipe work. It illustrates a method quite often used for detailing and is designated as the "chain" or "link" method of detailing. It is quite ingenious and enables one to make details of members in a small space to a comparatively large scale.

It will be noticed that the line *AC* is a broken or "chained" line and that *CG* is drawn to the proper slope or bevel as is also *AF*. The dimension *AC* is a calculated one, while dimensions *CD* and *AE* are determined by drawing in the rivet spacing according to the spacing given in the handbooks. This will enable us to decide upon the proper size of plates, and also to locate correctly the end of the members *AB* and *BD*. By adding ¼ inch for clearance between the columns and the ends *A* and *D* to distance *C*, as given in Table II, we will be enabled to locate rivets *A* and *D* in Fig. 10 and provide sufficient metal at the ends of *AB* and *BD* as shown. The details are drawn to a scale of one inch to one foot, while no regard has been paid to scaling *H J* or *H K*, these being placed at sufficient distances apart to enable the details to be drawn in at a suitable working scale.

Fig. 11 is a complete shop drawing of one-half of a steel roof truss of a knee braced mill or factory building suitable for a machine shop, and is more fully detailed than is customary; the details were put on to make every point clear to a class in structural design as it was intended to have the pupils construct it in the shop attached to the college.

It will be observed that some of the web members, as *Q R*, have what are called clip angles attached to them. There are

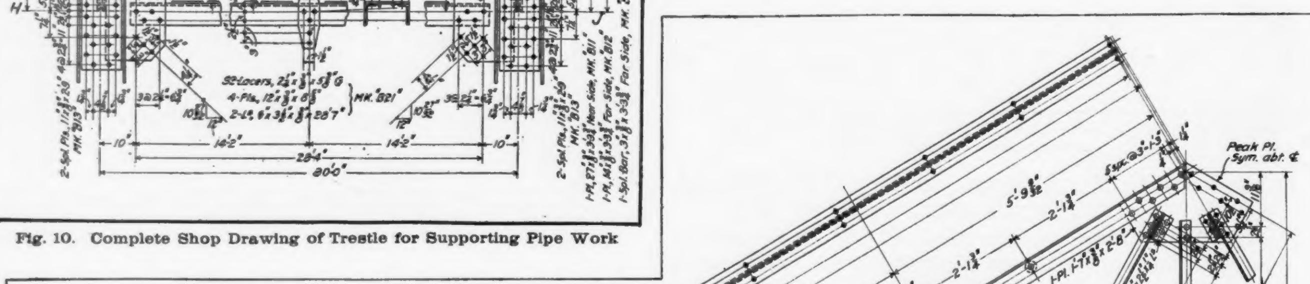


Fig. 11. Complete Shop Drawing showing One-half of a Steel Roof Truss

plates will ride the fillet and fail to fit properly, unless the plate edge is ground to fit the fillet, which is sometimes done. The distance *d* should be taken so that the center of the hole from the fillet as given by the distance *c* is not less than 1½ times the diameter of the rivet.

two objects in this—one is to dispense with such a wide gusset plate, and the other is that some engineers will allow only one leg of an angle to be counted as effective unless both legs are in some manner connected with the gusset plates.

The writer has observed that very little attention is given

to the thickness of gusset plates and that the favorite thickness appears to be ¼ inch and 5/16 inch. Except in very light trusses, economy and efficiency demand thicker plates than these sizes. A safe guide in this respect is to use a plate having such thickness that the bearing of the rivet on the plate is approximately equal to the rivet in double shear. The result of this will be to reduce the number of rivets and also the size of the plate.

Conclusion

In closing this article, the writer cautions against putting any joints in structural work under eccentric stresses; but when this is unavoidable, such cases may be handled as shown in the May and August, 1910, issues of MACHINERY, engineering edition, pages 739 and 980.

* * *

INTERESTING TOOLS AND METHODS OF CINCINNATI SHOPS—5

THE BRADFORD MACHINE TOOL CO.

By ETHAN VIALL*

Extreme care and accuracy are the watchwords of every one in the shop of the Bradford Machine Tool Co., from the superintendent down to the newest apprentice. Most of the men and foremen have been taught and trained in the shop by Superintendent Johnson and the "pull" is one great "all together."

Realizing to its fullest extent the importance of knowing what his competitors are doing, as well as other machine tool builders in allied lines, Mr. Johnson has a very convenient and complete catalogue filing case, Fig. 1, within easy reach of his desk. A supplementary card index shown at the left is also used in connection with the cabinet. Cases or glass frames in which are placed lists of employes and their clock numbers are shown in Fig. 2. The list is ruled into four columns: The first column contains the name; the second, the number; the third, the occupation; and the fourth, the name of the foreman in whose department the man works. A feature of the list is that while the entries in the last three columns are fixed, the names of the men may be easily changed, as they are written on slips of cardboard and inserted so that the name shows through a slot in the mat.

An exceedingly convenient and safe holder for rolls of blue printing paper is shown in Figs. 3 and 4. A roll is placed in the dark-box with the edge sticking out under the metal strip and any amount may be pulled out and torn off without exposing the rest. A view of the dark-box, open, is shown in Fig. 4.

One of the very important points of a lathe is the accuracy of the lead-screw, and Bradford lead-screws are guaranteed to be within exceedingly narrow limits. The lathe on which the lead-screws are cut is a specially-built machine with a thirty-two-foot bed, and extreme care is taken to keep it in perfect condition. A view of the half of the machine next to the head is given in Fig. 5, and a view of the middle section, including the carriage and follow-rests, in Fig. 6. In roughing out, two tools are used and as Fig. 5 shows, the driving spindle has an adjustable extension on it, so that when short lead-screws are being cut they may be set at any part of the bed and the wear does not necessarily come all on one section of the lead-screw and bed as would otherwise be the case. A master screw, made by Pratt & Whitney especially for cutting the working lead-screws, is attached to the back of the lathe in such a way as to be easily geared to the spindle and it drives the tool carriage from the back. When not in use, the master screw is kept covered with sheet metal guards. Fig. 7 shows a section of the master screw in position, with some of the metal guards removed.

Great care is taken to perfectly balance the driving cones, and in order to get good results, the cones are machined both inside and out. The boring-bar used to turn the inside of the cones may be interesting and is shown in Fig. 8. The bar is held in carriage bracket A, in which it may be set to any position by loosening the cap-screws B. Bracket C is a guide and steady-rest for the bar and it may be moved along the bed and clamped in any position. This bracket has a cross-slide which permits a cross movement of the carriage, and the bar is not locked but is allowed to slide in the pillow-block. Previous to boring, the cones are roughed off on the outside with a gang of tools, as shown in Fig. 9.

Fig. 1. Catalogue Filing Case

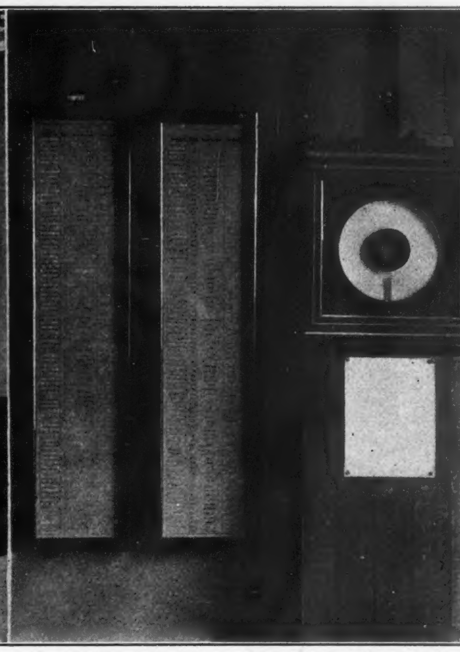
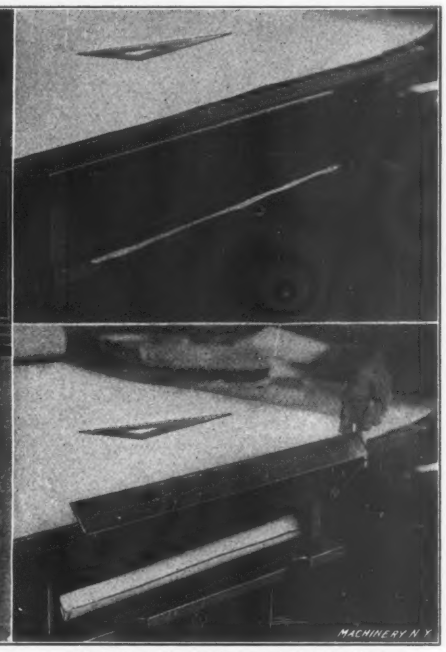


Fig. 2. List of Employes giving Occupations and Names of Foremen



Figs. 3 and 4. Blueprint Roll-holder, Closed and Open

The spacing steps for the change-gear lever are milled as shown in Fig. 10, the end mill used having a special geared extension head A, which makes it possible to reach the spots to be milled without extending the shank of the mill so much as to make it springy. The gear box is held in a fixture so made that the box may be revolved on the axis of the gear shaft in order to keep the milled surface of each spot radial. The back of this fixture is shown in Fig. 11, B being the handle that revolves the gear box, a graduated collar giving the proper radius. In using this arrangement, the end mill is set to the proper height above the table by means of the height gage C. After the first spot is milled, the radial distance is measured by turning the handle B a certain number of thousandths, and the horizontal spacing is accomplished by using the set of plugs D, on the cross-slide, as at E.

Circular T-slots for compound rests are cut in a lathe fitted with a turret, the slotting tools being set into adjustable holders as shown in Fig. 12. An enlarged view of one of these holders is shown in Fig. 13. The first circular slot is cut by the tools A and B. Tool A is notched to break the chip, and

* Associate Editor of MACHINERY.

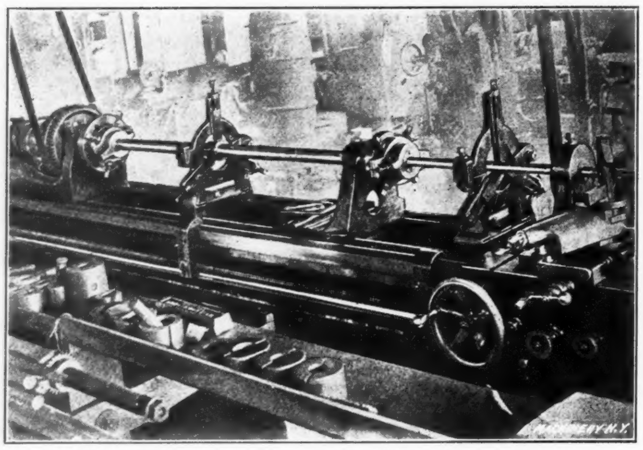


Fig. 5. One End of the Lead-screw Lathe—Note Extension Driving Head

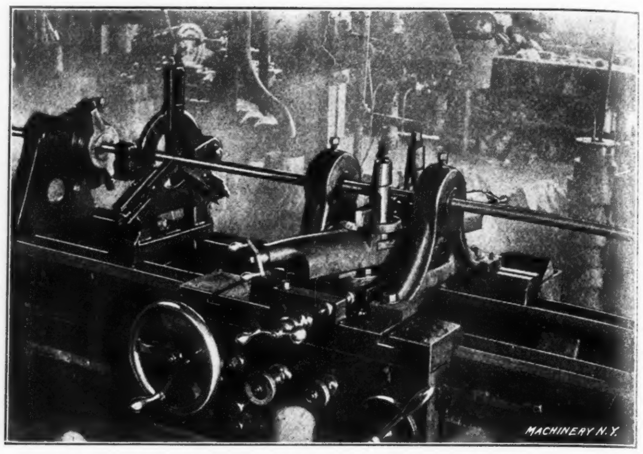


Fig. 6. View of Lead-screw Lathe Carriage

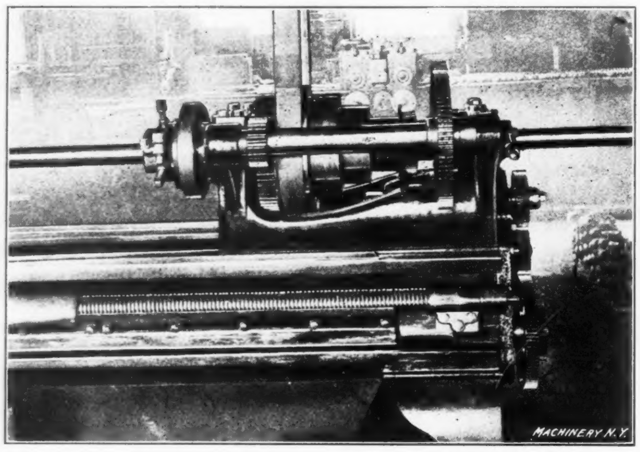


Fig. 7. Rear View of Lead-screw Lathe showing Master Lead-screw

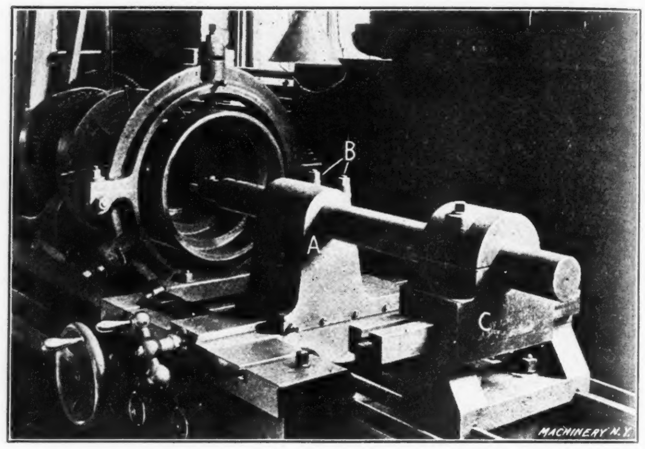


Fig. 8. Equipment for Boring the Inside of Cone Pulleys

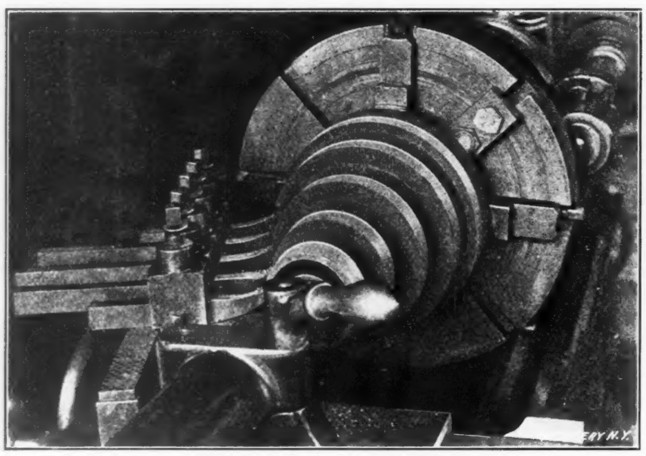


Fig. 9. Turning the Outside of a Cone Pulley with Gang Tools

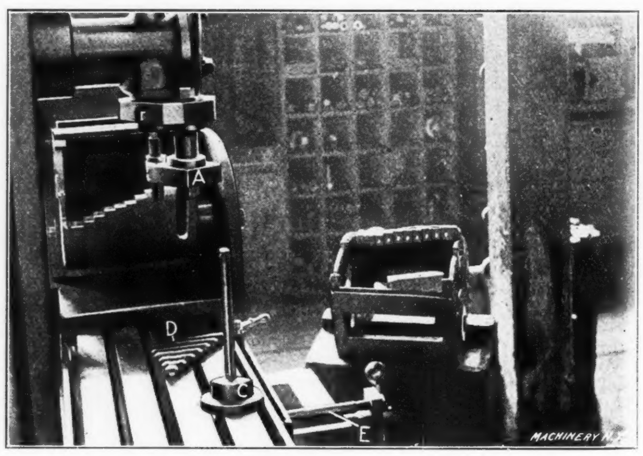


Fig. 10. Fixture, Extension Mill and Plugs used in Machining the Lever Steps of Change-gear Box

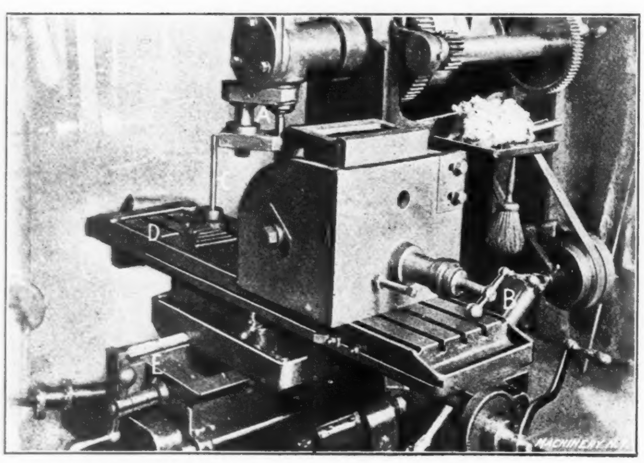


Fig. 11. Another View of Change-gear Box Milling Fixture

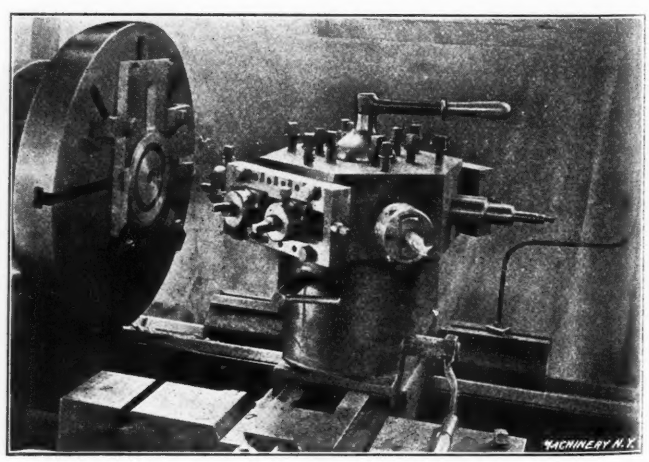


Fig. 12. Method of Cutting Circular T-slots

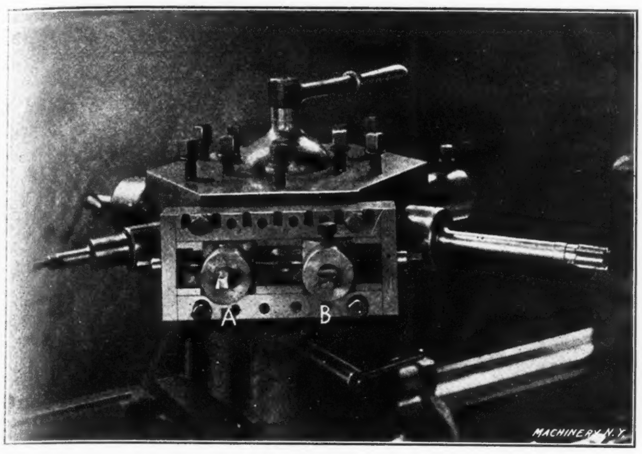


Fig. 13. Detail View of Adjustable Tool-holder used for Cutting Circular T-slots

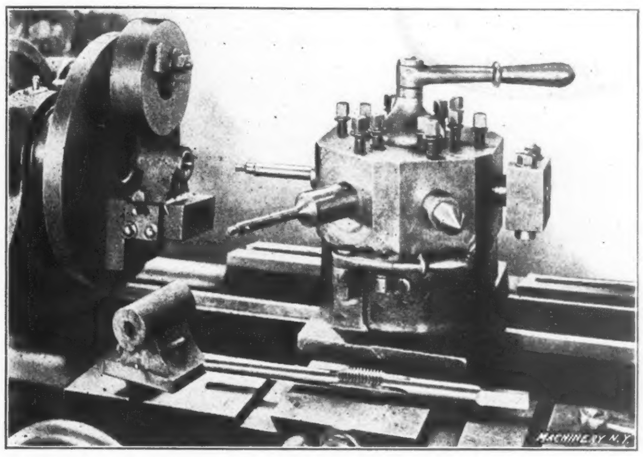


Fig. 14. Fixture and Tools used for Drilling, Boring and Tapping Apron Half-nuts

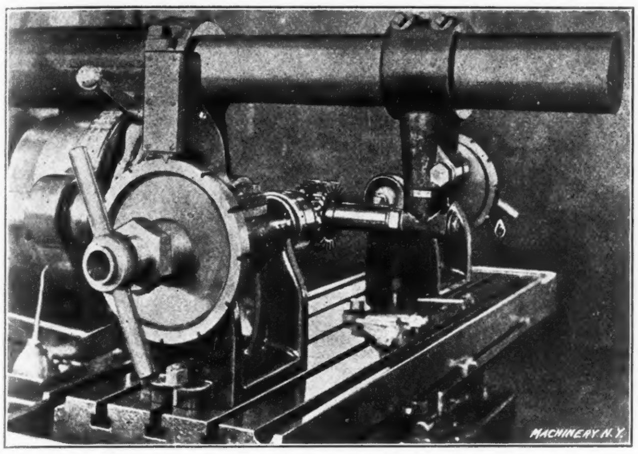


Fig. 15. Indexing Fixtures for Milling Bolt-heads

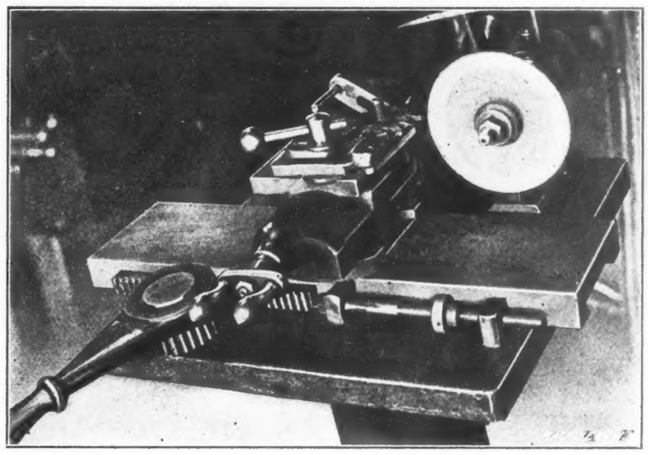


Fig. 16. Gear-cutter Grinding Fixture

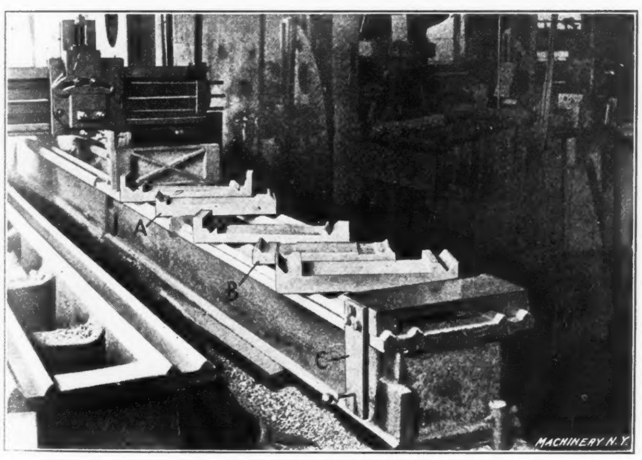


Fig. 17. Templets or Gages for Bed V's

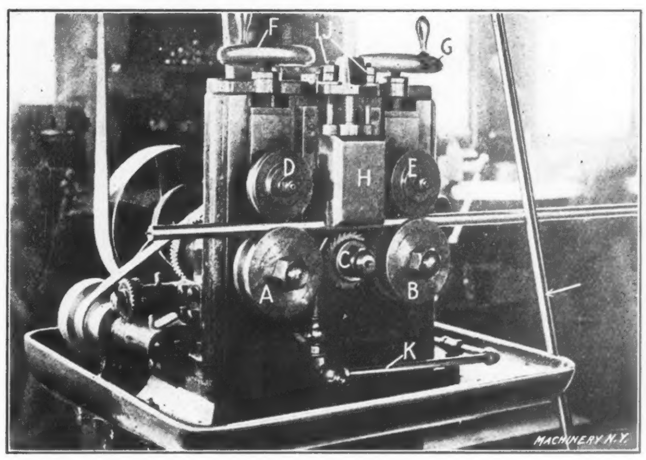


Fig. 18. Special Machine for Milling Splines in Lead-screws

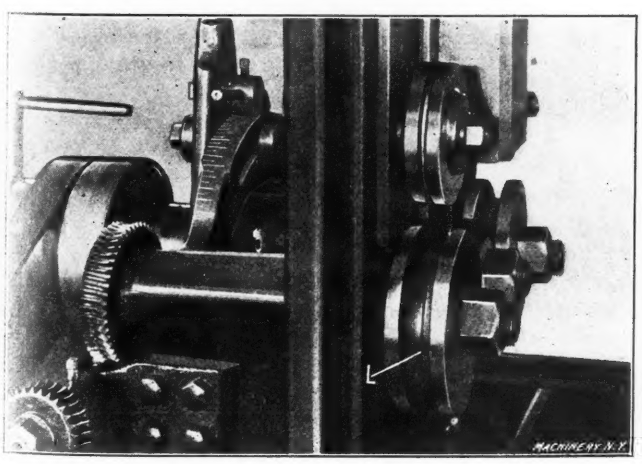


Fig. 19. Detail View showing Feeding Guide-rolls of Spline Miller

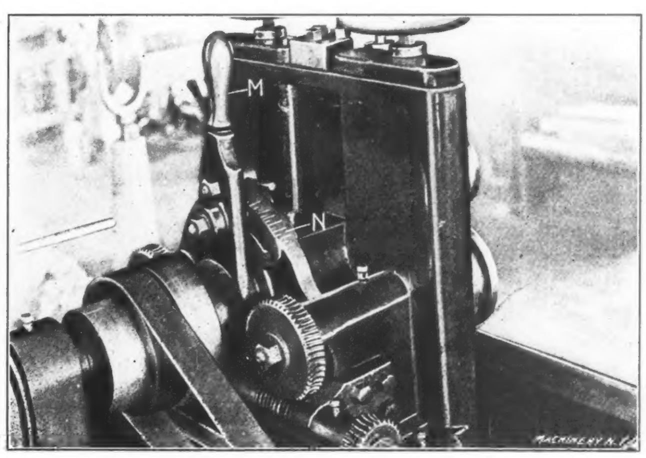


Fig. 20. Rear View of the Spline Miller

tool B cuts out the ridge left by the notch. After the circular slot has been cut to the right depth, the T is worked out by two L-shaped cutters in another holder in the turret (similar to the one shown) which are fed in by moving the turret along the cross-slide, after which the turret is brought back and located in a central position by the aid of a latch pin.

Apron half-nuts are drilled, bored and tapped while held as shown in Fig. 14, after which they are split in a milling machine.

Squares on bolt heads are milled with straddle mills while the bolts are held in the fixtures shown in Fig. 15, the spindle of which is fitted with a draw-in collet. Two of the indexing fixtures are used, one on each end of the table, so that work may be removed and inserted in one while the cut is being taken on the work in the other. Large indexing plates with twelve divisions are used, giving steadiness and accuracy and making them available for several classes of work.

Fig. 16 shows the gear-cutter grinding attachment used in the shop, and Fig. 17 shows the gages or templets used on the V's of the lathe beds. Gages A and B are of the half-V type, while C is a gage used to measure the height of a boss in relation to the position of the V's.

The long keyways or splines in lead-screws are cut in the special machine shown in Fig. 18. Rollers A and B are for feeding; C is the cutter; D and E are pressure rollers that are adjusted by the hand-wheels F and G; H is a steady-rest for the cutter and is also adjusted by a hand-wheel, stops being provided at I and J; and K is the pipe which carries oil to the cutter. The shaft being cut is kept from twisting as it feeds along by a circular guide key L, Fig. 19, which fits the milled keyway. Fig. 20 is a rear view showing the way the feed rollers are driven. In this engraving M is the handle used to feed in the cutter, the part N being graduated to show the depth of the cut.

* * *

ETCHING BRASS NAME PLATES HAVING BLACK BACKGROUNDS

The etching of brass name plates is a process of recent years which has succeeded in driving out the cast bronze or brass name plates to a great extent, on account of its cheapness. The etched plate can also be used in many cases where a cast plate would not do. The ordinary etched brass name plate as now made, is produced by coating a flat and polished sheet of brass with a thin layer of bichromated albumen, and by exposing it to the light for a few minutes under a glass negative upon which are a number of the desired name plate designs. The brass plate is then developed, which removes the albumen not exposed to the light (or that protected by the black portions of the negative) and leaves the brass free to be etched. The etching solution will not attack the parts protected by the albumen (or "resist," as it is called). Another way is to transfer a design to the brass from a master plate, or to use other materials, as for example, asphalt, for the resist. The ultimate effect in all cases is the same.

The etching is done by means of a solution of perchlorate of iron or by making the anode in an acid copper solution. When the required depth has been obtained, the sheet containing the number of name plates thus etched is washed, and, without removing the resist, it is treated in some manner to produce a black background. When this has been done, the resist is removed and the sheet is cut up to produce the individual plates, after which each plate is lacquered and is then ready to be sent to the customer.

After the brass plate containing the name plates has been etched the resist is allowed to remain on it. If the etched surface is tarnished, as it usually is when standing in the air after etching and drying, a solution made of 2 parts of water and 1 part of muriatic acid is spread over the surface which will immediately remove any stains and leave the etched surface clean and uniform. The plate should then be rinsed, but not dried, and the operation of producing the background should begin immediately. If allowed to dry stains will again appear.

Producing a Black Background

Three methods are in use for producing a black background on etched brass name plates; but whatever method is used, the preliminary operation of etching is the same. The methods in use for making the black background are as follows:

Black Nickel

The use of a black nickel deposit is the best method of producing a black color on the etched name plate. The solution does not affect any of the various kinds of resist used and a large number of plates can be treated in the tank at one time. The solution that is used is the well known black-nickel bath and is made as follows:

Water	1 gallon
Double-nickel salts	8 oz.
Ammonium sulphocyanate	2 oz.
Zinc sulphate	1 oz.

The solution is used cold with a weak current. The best results are obtained when a current of about 1 volt tension is used. If a greater voltage is used, the deposit will be streaked and gray. It will also become gray if the solution is too weak. As soon as the deposit is black, remove the plates, rinse, dry and cut them to the desired sizes, after which they should be lacquered immediately, in order to prevent the brownish discoloration which forms on the surface of the deposit after standing some time. As previously mentioned, black nickel is the most satisfactory black background for the name plates. It can be used on metals such as yellow brass, copper, bronze, etc.

Oxidized Acid Copper Deposit

An excellent method of producing a black background is to first give the etched plate a deposit in an acid copper solution and then oxidize in liver of sulphur. The acid copper solution is made as follows:

Water	1 gallon
Copper sulphate	2 lbs.
Sulphuric acid	1 oz. (fluid)

The etched plate is allowed to remain in the solution until a good copper deposit is produced on the background. This takes from 15 to 20 minutes, when a current with a tension of about 1 to 2 volts is used. The deposit gives a red and matt surface. The plate should then be removed, rinsed and oxidized immediately in the following solution:

Water	1 gallon
Liver of sulphur	2 oz.

This liver of sulphur solution should be used cold, and it will not act upon the resist. It is used as a dip and not with the current. A minute or two is required to produce the desired color, when the plate should be rinsed and dried. The color is a good black and as the copper deposit is matt or "dead," it is quite pleasing for many classes of work.

Ammonia Black

The ammonia black (so-called) is produced by oxidizing the name plates in a solution of copper carbonate in ammonia water. It is used as a dip, and it is not as easily done as the other methods previously mentioned. It must be done in a warm solution in order to obtain a good color and this is apt to attack some resists; in fact, not all resists will stand it. To use this method the following solution is made up:

Water	1 gallon
Strong ammonia water	1 gallon
Copper carbonate	an excess

By the word "excess" is meant that as much copper carbonate should be dissolved in the solution as can be taken up, and yet have a slight amount remain undissolved. Unless there is a slight amount undissolved, the dip will not work well. The solution then has a blue color with a green sediment in it.

In order to produce the black on the plates, they are dipped into it while warm. It has been found that while the solution will produce a color on the plates when cold, it is not uniform or black, but slightly brown, although it may be used for some classes of work. The solution will begin to work well when a temperature of about 120 degrees F. is obtained. It works better and more rapidly, of course, when a higher temperature is employed, about 160 or 170 degrees F. generally giving good results. This heat, however, is apt to melt the resist and a lower one is recommended. The dip is used in an earthenware jar surrounded with warm water.—*Brass World.*

A SYSTEMATIC SCRAP-BOOK

By R. E. ASHLEY*

A pile of technical publications, each one preserved because of perhaps but one article, and that only half a column in length, drawers and boxes full of clippings, blueprints, drawings, sketches, leaves and tables from old text-books and catalogues—this was the state of affairs which the writer found after some fifteen years in the engineering profession. This, also, is the condition of the accumulations of information and reference matter of hundreds of other engineers, and men of similar professions. Almost any one knows what it means to look for a particular reference, article, or information pertaining to a certain subject, among such a conglomerate mass of scraps. One can hardly pick up a technical publication without finding therein some article pertaining to his particular branch of the profession, or to a branch so closely allied that he feels the article is worth saving, and straightway proceeds to cut it out and lay it away in a box or drawer with years' accumulations of like scraps. Every engineer the writer has come in contact with has recognized the importance, yes, one might say, the necessity of saving those articles and papers which come to him from various sources.

The question of how to care for these scraps, arrange them in some systematic order, and index them so that any article or reference can readily be found when wanted, has always been a perplexing one. A great many have tried pasting them in an ordinary scrap-book, but this has never proved satisfactory, and in most cases is abandoned after a short trial. One of the former greatest objections to this method of keeping a scrap-book, was the inability to keep it properly indexed. Usually a book of considerable size was employed, and it was impossible to index the book in a satisfactory manner until the book was full. This meant that it might be two or three years that the scrap-book would have to be used without an index, making it necessary to look through it from beginning to end until the clipping or article sought was found. Those who tried to index the book as they went along, soon gave up in despair for they found that no matter how carefully and systematically they started out, sooner or later they found it necessary to index an article where not enough space had been left to enter the subject in its proper place. This meant that the index of any particular scrap-book soon became little more than a list of the clippings contained in it, and that it was nearly as easy to look through the book in the first place as it was to attempt to find the required articles in the index. Another objection to the scrap-books was that they were seldom large enough to accommodate articles which included several pages from large-sized publications.

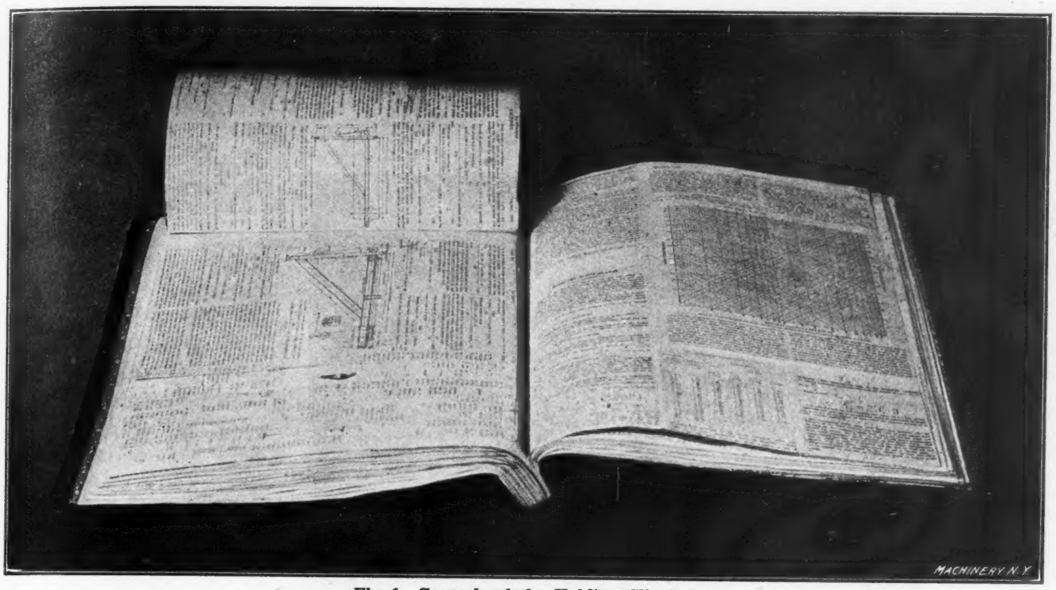


Fig. 1. Scrap-book for Holding Clippings

The development of the loose leaf systems—books that can be made any size, both as to page and thickness—and the card index system, each with its unlimited expansibility, now make it possible for an engineer to take care of his clippings and miscellaneous information where it would not have been possible before the advent of these systems. The writer has recently completed the work of compiling, classifying and indexing his "scrap file," and it has proved so satisfactory that this article is written in the hope that it may help some one who is experiencing the same trouble and annoyance that the writer did before employing the methods about to be described.

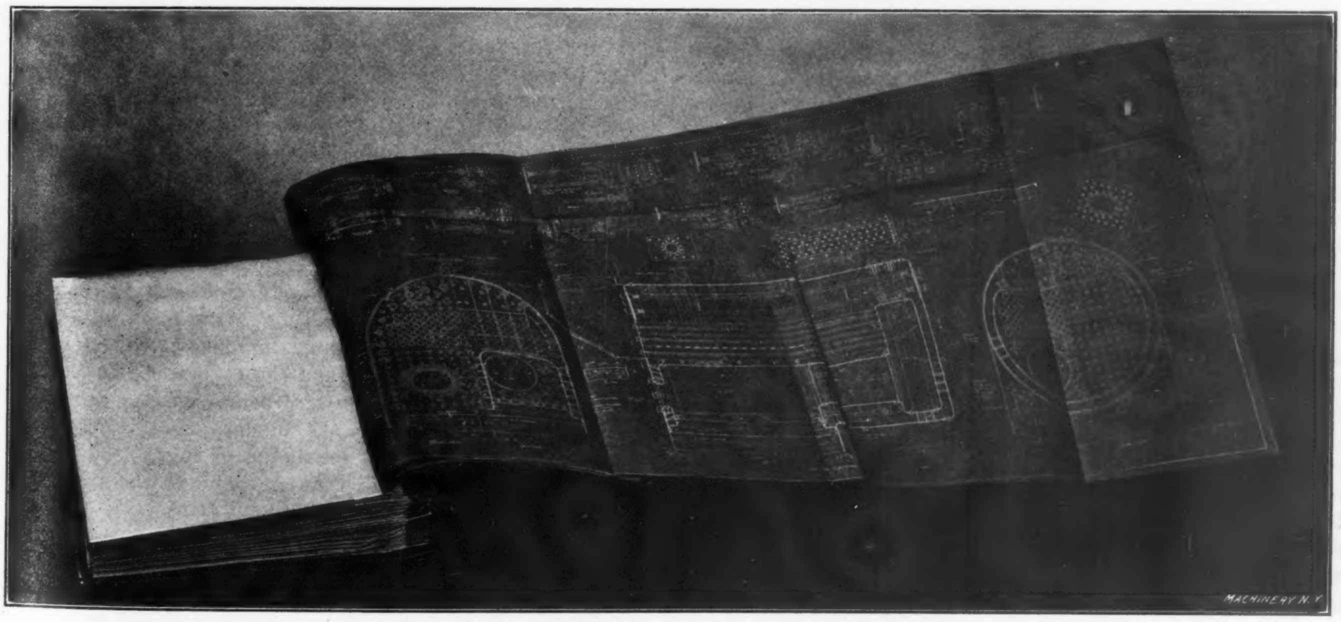


Fig. 2. Scrap-book for Holding Drawings, Prints and Sketches

In looking about for the most convenient forms and those that would be most likely to prove satisfactory and fulfill all conditions, the writer found it necessary to recognize the fact

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that before the "scrap file" could be satisfactorily taken care of, it must be divided into three classes:

1. That consisting of clippings which could be pasted in a book without altering them in any way.

2. That consisting of drawings, prints and sketches, which, because of their size, would be too bulky to put in a book with the clippings.

3. That which came to him in such a form that it had to be transposed or worked over before being applicable to his line of work; also that obtained in the solution of his daily problems.

To take care of the first class the writer ordered a 16 x 13 inch loose leaf flexible-covered binder, and a number of blank white sheets of heavy bond paper. On these sheets the articles were pasted in the most convenient manner, care being taken to so arrange them that the entire page could be utilized. Those articles which were printed on one side of the paper only, were trimmed and pasted in columns corresponding to the regular arrangement of a two or three column page. To do this it was often necessary to divide the article, cutting between the lines of printing as might be necessary to fill out the columns in the scrap-book. Lengthy articles which consisted of several pages of a publication were pasted on one edge only, so that both sides of the clipping would be accessible. In the case of such articles, either an entire leaf was utilized, or else one article would be pasted at the top of one page and another at the bottom on the opposite side of the leaf, in this manner building the book up evenly. Necessary fillers, of the same material as the pages, but only one inch wide, were employed in the binding to build to the thickness of the pages. No attempt was made to arrange different articles pertaining to the same subject on the same or adjacent pages, the size of the article being the only factor determining its position in the book. With a little planning it was found possible to arrange the articles in a neat manner and with little or no loss of space. Fig. 1 shows the loose leaf scrap-book in which articles of the first class are kept. On the right-hand page are shown articles pasted fully on the sheet, while the left-hand page shows the longer articles, each comprising several pages of a publication, the pages being pasted on one edge, leaving both sides available.

To take care of the second class, a cover the same as above described was used. The manufacturers of the covers furnished binding strips consisting of two pieces of cloth 1½ inch wide, having a paper filler 1 inch wide, all being flush on the back edge. The inside of both pieces of the cloth, on the inner edge, was gummed so that by moistening it the edge of a print or drawing could be inserted and secured to the binder. The sheets were then folded to exactly 16 x 13 inches, the book in this manner being built up as true as any loose leaf book. The binder in this case served as a filler. Fig. 2 shows the loose leaf book for taking care of Class 2 and illustrates how well it is adapted to hold any sized drawing.

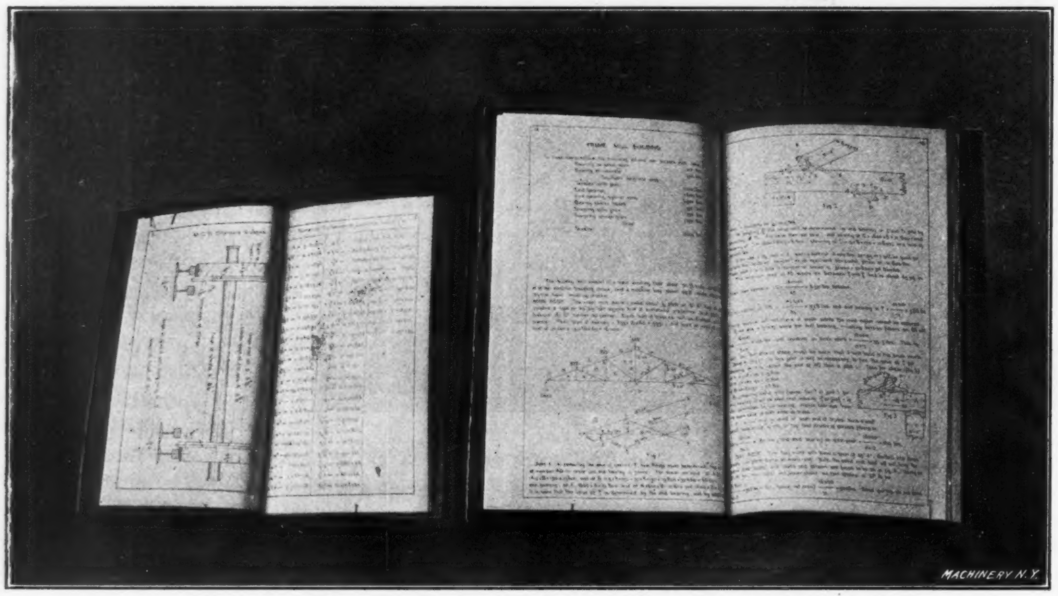

Fig. 3. Scrap-book for Holding Revised Matter and Solutions of Daily Problems

For the third class two flexible loose leaf covers were used, one 7½ x 4½ inches and the other 9 x 6 inches. Leaves for both books were procured from a local printer with the border lines printed on both sides. This saved ruling them by hand, and was a help in squaring work on the page. The small book was used for preserving tables, formulas, etc., collected from various sources or worked out by the writer in the execution of his regular duties, and the volume is intended to become a pocket- or hand-book which every engineer should compile for himself, containing that information most often used by him, and arranged with special adaptation to his own particular line of work. The larger book was used for preserving the more extensive computations, forming complete records of the calculations, step by step, of the design of a machine, or for instance a frame mill building as the illustration shows. The work in both books, thus far, has been put in by hand, although a typewriter could easily be used as each sheet is completed before being put into the book, after which the pages are given their proper number. A thin strong paper is used which will take ink readily, stand erasing, and from which, when India ink is used, blueprints can be made where but one side of the leaf has been used. Fig. 3 shows the two books in which information in Class 3 is entered.

The leaves for the different books were obtained, and then cut to size. Holes were then punched to the proper gage by a tool purchased for that purpose, and which can be obtained from any manufacturer of loose leaf outfits. This method of binding proved to be so easy and satisfactory, that it occurred to the writer that he might become his own book binder. He had the numbers of a technical magazine covering several years, which were scheduled to be bound, some time in the future, in the usual manner. Instead of binding, however, several stiff loose leaf binders of the correct size were ordered, the magazines taken apart, advertising matter discarded, and the balance punched and filed in the binder according to volume and page number. Each magazine as soon as received, read, and indexed is punched and put in the binder. In this way there are no loose numbers lying about—each one being in its place. The covers are bound in black leather, the name of the publication appears on the back in gold, and the covers as they stand in the case have every appearance of being so many volumes of a standard set of books. Each binder has a minimum capacity of two years, and a maximum of four. The cost per volume is considerably less than if bound in the usual solid form.

In compiling the index much time was spent at first, in considering just what would be required to make it complete and yet simple, so that the keeping up to date would not become burdensome. It was realized that the success and practicability of the index depended largely upon the subjects, and sub-headings into which it should be divided, and the extent to which the sub-headings should be carried was a question. However, as it afterwards proved, this matter worked itself out satisfactorily as the index was built up. The subjects chosen under which the index was divided were: manufactures, materials, machinery, boilers and accessories, fuel, hoisting machinery, laying-out problems, pneumatic, engines, structural, tanks, towers, pipe, electrical and miscellaneous. The subject machinery has twenty-six sub-headings such as stresses, shafts, couplings, flywheels, etc.; boilers and accessories has twenty-one, such as water-tube, fire-tube, vertical, in-

ternal fired, feed water, furnace, joints, draft, etc.; and all other subjects have sub-headings, the number depending upon the importance of the subject and the extent to which they would simplify the index. In addition, each subject has its alphabetical index for miscellaneous articles which would not come under any of the sub-headings.

The regular 3 x 5 inch index card was used, and filed in a two-drawer cabinet. Each subject has its distinctive color as far as possible, and where it is necessary to use the same color of card for two subjects, they are so widely separated that there is no danger of confusion. Each card, besides having its identifying color, has the subject written at the top, so that should the index become "pied" (such a condition is not an impossibility) it would be possible, even for a stranger, to replace each in its proper place.

Each book containing information has its number placed on the inside of each cover, and the index card refers one to book number and page. For instance if the writer were designing a special boiler, and because of certain limitations found it necessary to make the grate surface as small as possible, and desired to learn what various authors had to say on the matter, he would look under the sub-heading "furnaces" of "boilers and accessories," and on the card would find "Ratio—heating surface to grate surface 4-17, 7-39, 2-104, 10-43," which would mean that one article would be found in book number 4 page 17, another in book 7 page 39, etc.

The index at present contains nearly 2000 cards and so completely has it been carried out, that if necessary to look up information on any subject, and such information is contained in any of the loose leaf books above described, text-books, hand-books, bound volumes of magazines or catalogues owned by the writer, references can be found in a moment's time in the index, which will direct one to the several page numbers of the different books where such information is to be found. On several cards at the front of the index is given the number assigned to each book, and opposite a description of such book, consisting of the title, author, and volume number (should it be one of a set of books), these cards serving as a key to the index.

It may occur to the reader that the keeping of the scrap-book and index would involve too much time and labor—more than the average engineer could devote to it—but this is not the case. It must be borne in mind that only those articles are preserved and indexed that are valuable, and as a typewriter is used in writing the index cards, one or two evenings a month has been found sufficient to keep the "scrap file" in shape.

* * *

FLUX FOR COPPER AND BRASS

In melting copper for producing brass or bronze there is no flux better than common salt. Its value lies in the fact that it possesses the property of reducing any oxide of copper which may form during the melting. It has been used for years in the brass industry and the memory of the "oldest inhabitant" fails to indicate the date of its inception. About a handful of salt is used and is preferably put in the crucible after the copper has begun to melt. If introduced with the copper, it melts before it and is apt to volatilize and waste. The action on the crucible is also greater. Too much salt produces a liquid that is apt to penetrate the crucible like fluor-spar, although not as violently or as rapidly. The amount of salt previously given is used for a pot of metal holding about 150 pounds. The quantity need not be exact, as a variation either way does no harm as long as a sufficient quantity is used to do the work. Common salt is almost universally and exclusively employed as the flux in brass melting. The brass rolling mills in the Naugatuck Valley, Connecticut, and elsewhere as well, all use it, and one large company uses approximately half a ton a day. It is the universal and only flux used in making brass for rolling. It seems to give all that is desired and has the distinct advantage of being cheap. Any kind of salt will answer the purpose, a pure material being unnecessary.—*Edwin S. Sperry in paper read before the American Brass Founders' Association convention.*

INTERNAL CUTTING TOOLS—3

PRACTICE FOR THE BROWN & SHARPE AUTOMATIC SCREW MACHINE

By DOUGLAS T. HAMILTON*

In this, the concluding article on the subject of internal cutting tools, recessing tools and recessing operations will be described. The practice given herein can be taken as standard and when used with discretion satisfactory results will be obtained. The speeds and feeds, of course, are liable to some variation on account of the conditions which govern them, but the feeds given herein are not exceedingly high and can be used to advantage in the majority of cases.

Three different types of recessing tool holders, commonly called swing tools, are described, but it will, of course, be seen that with slight modifications, tool-holders of the description given can be used for various classes of work. Three types of recessing tools are also shown. These are suited for three different conditions, namely, for chamfering and recessing operations, and for special conditions—that is, the third tool is used when the hole in the work is so small, as not to permit the use of either of the other tools. Explicit instructions are also given for laying out cams for chamfering and recessing operations.

Recessing and Recessing Tools

When it is necessary to chamfer a hole in each end of a piece, a recessing or so-called "internal" chamfering tool is used, which eliminates a second operation. A recessing tool which works on the same principle as an ordinary boring-tool is used for chambering or relieving a hole in the center, that is, just leaving a bearing surface at each end. The recessing or chamfering operation should always precede the reaming operation, so that all burrs thrown into the hole by the recessing tool will be removed by the reamer. A recessing or chamfering tool should be operated from the front cross-slide wherever possible, for the following reasons: In the first place it is generally more convenient to make the necessary adjustments; in the second place turning the tool upside down allows the chips to drop to the bottom of the hole where they are easily removed, thus allowing the tool to work with less obstruction; and in the third place, the forming is usually done from the front cross-slide, thus requiring the use of the rising block. This, the latter, is removed for the substitution of a special rising block which has a cam attached, used for operating the recessing tool holders. It is, therefore, obvious that this is generally the correct place from which to operate the recessing tool holder.

If, on the other hand, the recessing tool holder is operated from the rear cross-slide, the recessing will either have to be done when the spindle is running backwards or else it will be necessary to make a special circular tool holder, in which the distance from the hole through which the screw is inserted to hold the circular tool, to the top face of the cross-slide is of a less height than that ordinarily used on the rear cross-slide.

In cutting the finished piece from the bar after recessing, the feed should be decreased on the cut-off tool, so that the piece will be severed without leaving a burr where the two cuts meet. Decreasing the feed from 0.001 to 0.0005 inch per revolution is generally found sufficient.

At *A* Fig. 16 is shown a recessing tool which is used for chamfering, and at *B* is shown a tool which is used for chambering. This latter tool removes the superfluous material in a similar manner to an ordinary boring-tool.

The chamfering tool shown at *A* is not backed off, as it is smaller in diameter than the hole in the work, which gives it sufficient periphery clearance on the sides. For brass work, the cutting edge is cut on the center as shown and sometimes below the center when less clearance is necessary, as shown by the dotted line *a*, but for steel work it is cut above the center a distance equal to 0.10 of the diameter and given a top rake. The included angle of the cutting edge β is made as required, the angle usually being about 90 degrees.

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The recessing or boring tool shown at B has its sides cut helically, giving a clearance angle of from 5 to 8 degrees which is found satisfactory for ordinary work. For brass work this tool is also cut on the center and below, as shown by the dotted line b, and for steel work the same as for chamfering tool A.

Where the hole in the work is of such a diameter, that a tool made similar to those shown at A and B would be too slender to do efficient work, one similar to that shown at C and D can be used. The diameter of the cutting end of this tool need only be about from 0.008 to 0.012 inch smaller than the hole. The distance a should be about 0.015 inch greater than the depth of the recess, and b, of course will equal $\frac{a}{2}$. The amount c that the cutting edge is cut below the center, should be enough to give the tool sufficient negative rake for brass, but for steel it should be cut 0.10 times the diameter above the center.

A good method of making this tool is as follows: Take a piece of drill rod of a diameter equal to the diameter of the shank required and insert it in a draw-in chuck held in a bench or other suitable lathe. Turn down the body of the tool equal to the diameter required, then remove the tool from the chuck replacing it with a narrow strip of sheet steel or brass alongside of it, the thickness of which will equal the dimension b Fig. 16. When the tool has been tightened in the chuck, light cuts can be taken until the desired amount of material is removed.

When the tool has been turned eccentric, as shown at C, a small groove is milled in it as shown at D, and the tool backed off for clearance. It is then hardened and drawn very carefully in oil.

If the amount of eccentricity required on the tool is such that the tool could not be held firmly in the chuck with a piece of sheet steel inserted alongside of it, a bushing should be made with the hole eccentric to the outside diameter, an amount equal to the amount of eccentricity required on the tool.

Chamfering and recessing tools should be made slightly smaller than the diameter of the drilled hole and the body should never be longer than is really necessary to clear the work, allow the chips to pass out and the oil to penetrate to the cutting edge. For general conditions the following proportions for chamfering and recessing tools will be found satisfactory.

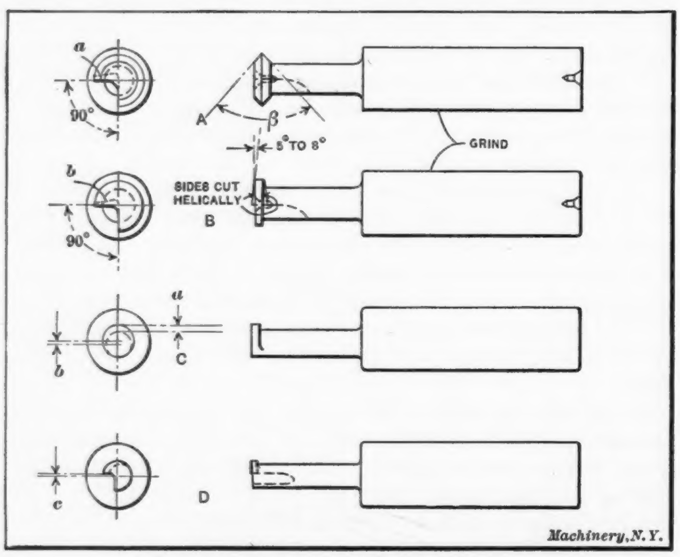


Fig. 16. Various Types of Recessing Tools

Proportions for Chamfering Tools (For Notation see Fig. 17)

Where A = diameter of hole before reaming or diameter of drill,

B = diameter of chamfering tool = A — 0.025 to 0.030 inch,

C = diameter of chamfered hole,

D = length of work or distance that tool projects in from the face of the work,

E = length of body of tool = 1.25 D,

F = diameter of body of tool = B — (2H — 0.025 to 0.030 inch) (when included angle = 90 degrees),

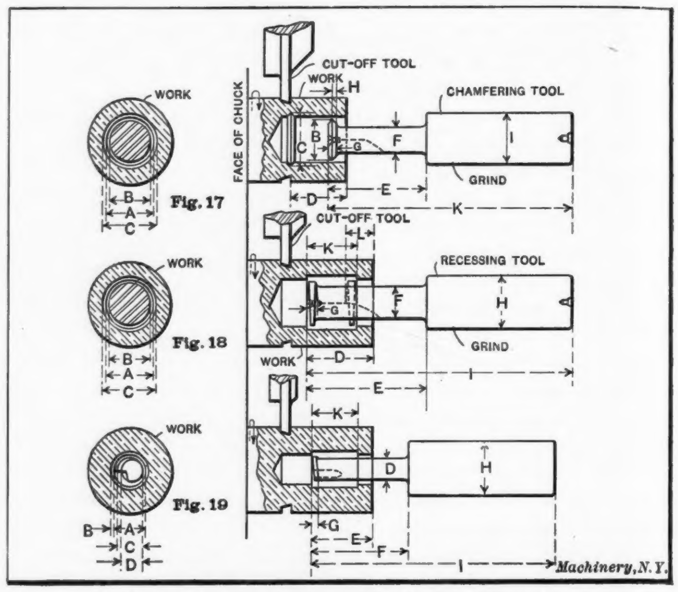
G = width of blade = 0.25 B = 2 H,

I = diameter of shank and is as follows:

When A = from ⅛ to ¼ inch I = ¼ inch.
A = from ¼ to ½ inch I = ½ inch.
A = from ½ to ⅞ inch I = 1 inch.

K = total length of tool and is as follows:

When I = ¼ inch K = E + ⅞ inch.



Figs. 17, 18 and 19. Diagrams Illustrating Method of Determining Proportions for Chamfering and Recessing Tools

I = ½ inch K = E + 1¼ inch.
I = 1 inch K = E + 1½ inch.

Proportions for Recessing Tools (For Notation see Fig. 18)

Where A = diameter of hole before reaming or diameter of drill,

B = diameter of recessing tool = A — 0.025 to 0.030 inch,

C = diameter of recessed hole,

D = distance in from face of work to extreme depth of recessed hole,

E = length of body of tool = 1.25 D,

F = diameter of body of tool = B — (C — B),

G = width of blade = 0.20 B,

H = diameter of shank and is as follows:

When A is from ⅛ to ¼ inch H = ¼ inch.
A is from ¼ to ½ inch H = ½ inch.
A is from ½ to ⅞ inch H = 1 inch.

I = total length of tool and is as follows:

When H = ¼ inch I = E + ⅞ inch.
H = ½ inch I = E + 1¼ inch.
H = 1 inch I = E + 1½ inch.

Proportions for Tools Used in Recessing Holes of Small Diameter (For Notation see Fig. 19)

Where A = diameter of hole before reaming or diameter of drill,

B = depth of recess,

C = diameter of cutting portion of recessing tool,

D = diameter of eccentric body of tool = B + from 0.010 to 0.020 inch,

E = distance in from face of work to extreme depth of recessed hole,

F = length of body of tool = 1.20 E,

G = width of blade = 0.20 B,

H = diameter of shank of tool and is the same as previously given for the other tools shown in Figs. 18 and 19.

I = total length of tool and is as follows:

When H is ¼ inch I = F + ⅞ inch.
H is ½ inch I = F + 1¼ inch.
H is 1 inch I = F + 1½ inch.

It will be noted that the lengths of the bodies E and F on chamfering and recessing tools will be governed to a con-

siderable extent by the character of the holder used, and the relative positions of the cross-slide tools during the recessing operation and also the depth of recessed hole required. Usually the proportions given will be found satisfactory for general work.

Recessing Tool Holders

In Fig. 20 is shown a recessing tool holder which is commonly called a swing tool. The swinging member *A* of this holder is held to the body *B* by a stud and screw *a*. The pin *b* held in the swinging member is kept tight up against the end of the set-screw *c* by means of a small coiled spring, not shown, which is held in the member *B*. The set-screw *c* is also used for bringing the tool concentric with the hole in the work. The set-screw *d* holds the recessing tool in the swinging holder. To operate this tool, the ordinary rising block which is used under the circular tool holder is removed, and the block shown to the right in the illustration is substituted in its place. This block is only for straight work, the cam *E* being adjusted longitudinally in a slot in plate *C*.

The rising block shown in Fig. 21 is made adjustable for taper work. Here it can be seen that the plate *C* has a longitudinal groove *c* cut in it in which the adjusting arm *D* can be adjusted in or out, as desired. When the desired position is obtained it is clamped by means of the screws *d*. On this adjustable plate *D* is fastened a swinging plate which rotates on the small pin *e* and is adjusted by the set-screw *f*. When this plate is set in the desired position it is locked by means of the screw *g*. This rising block can be used for a variety of

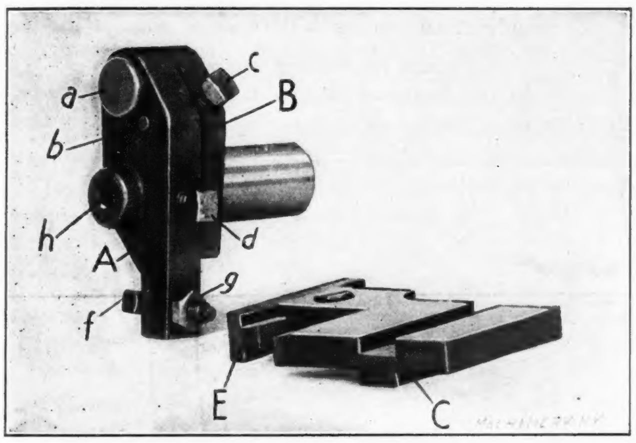


Fig. 20. B. & S. Swing Tool-holder and Rising Block for Operating it

work, as the setting and shape of the plate *E* will determine the shape produced on the work.

When it is essential to have a hole in the work concentric with the external diameter, a block as shown in Fig. 21 can be used in conjunction with the recessing or swinging tool holder shown in Fig. 20, the operation of truing the hole being similar to boring a hole in an ordinary lathe. For this class of work, of course, it is usually necessary to take only one cut, so that complicated cams are avoided, but, of course, this is only general and the work in hand will decide whether it would be advisable to take one or more cuts.

Returning to the swinging tool holder shown in Fig. 20, the set-screw *f* is also used as adjustment for bringing the recessing tool concentric with the hole in the work. A small clamping nut *g* is provided for locking it, when in the desired position. The size of the hole *h* in the holders for the various machines is as follows:

For the No. 00 machine, $h = 3/16$ inch,
No. 0 machine, $h = 1/4$ inch,
No. 2 machine, $h = 1/2$ inch.

In Fig. 22 is shown another design of recessing tool holder which will sometimes be found very convenient. In the tool-holder shown the swinging member *A* is held to the body of the tool-holder *B* by means of the screw *C*. The body of this screw which passes into the holder *B* is turned eccentric to that part of the screw which works in the swinging member *A*. A detail of this screw *C* used in a holder for a No. 00 machine, is shown to the right in the illustration. It can be seen that a slight adjustment is given with this screw, so that the recessing tool can be located concentric to the hole in the work. This is found to be a very practicable addition in some cases, especially where the hole in the work is extremely small, not allowing the difference between the external diameter of the recessing tool and that of the hole to be very great. This screw also provides for any inaccuracy in the

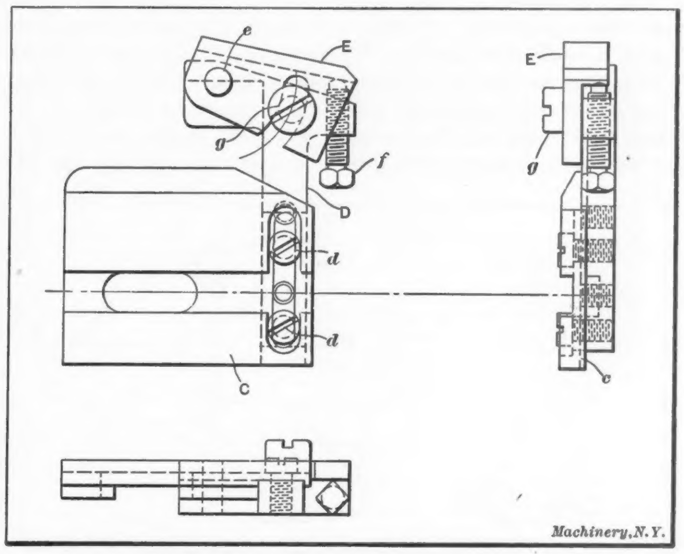


Fig. 21. Standard Rising Block used for Operating Swing Tools

making of the holder, as it is usually found a difficult proposition to get these tool-holders to line up exactly concentric.

The construction of this holder is somewhat different to that shown in Fig. 20, especially in the method of holding *A* to the member *B*. A shoulder-screw *E* is tapped into part *B* and is made a loose fit in the swinging part *A*, the latter having an elongated hole to allow the holder to swing. The head of the screw *E* allows the swinging part of the holder to slide easily underneath it. This holder has an adjustable stop *F* so that once the holder is set it will be brought into the exact position after having recessed one hole. The set-screw or stop *F* which bears against the body of the screw *E* is locked by means of a nut. *G* is the screw against which the operating cam attached to the rising block bears. This screw also has a shoulder which the small coiled spring operates, thus keeping the screw *F* held in the swinging member *A* up against the screw *E*. Split bushings are used for hold-

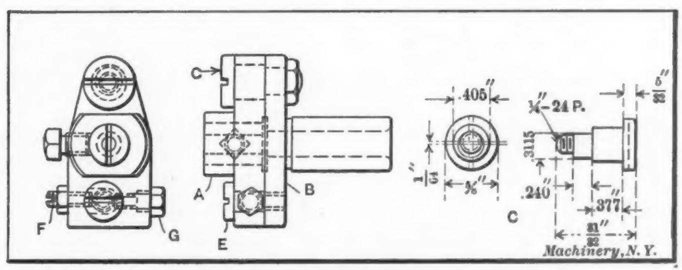


Fig. 22. Another Type of Swing or Recessing Tool Holder

ing the recessing tools in this holder. This tool can be made very accurately and can be used for fine ana delicate work.

Performing Facing Operations with Swing Tools

Swing tools are not only used for recessing and chamfering operations, but can also be used for straight, taper, irregular turning operations, and when necessary may be used for facing.

It is sometimes found necessary to cup out a piece of work which leaves a very thin wall. Now, if the ordinary facing tool were used in the turret, the cutting pressure would force this thin wall back, and as soon as the pressure was removed it would spring back again to its normal position, or nearly so, thus making it difficult to produce a perfectly square face in the work. For this class of work a swing tool as shown in Fig. 23 is found advisable. In use the facing tool *C* shown in the holder is brought up, of course, until the cutting edge is in line with the center of the work. When it is in this position it is fed a slight amount into the work

equal to the depth of the cut to be taken. Then the cross-slide advances, forcing the tool forward which turns the face similar to an ordinary facing operation in the lathe. If one cut is not sufficient to true up the face, of course a second cut can be easily taken. This method of turning will be found satisfactory when all others fail. This swing tool is constructed somewhat similarly to those previously described with a slight modification, of course, to suit the requirements. The turning tool C is made from a square section of either carbon or high-speed steel and is adjusted by means of the two set-screws A. The turning tool rests on the small pin B which acts as a fulcrum. By means of this pin and the two

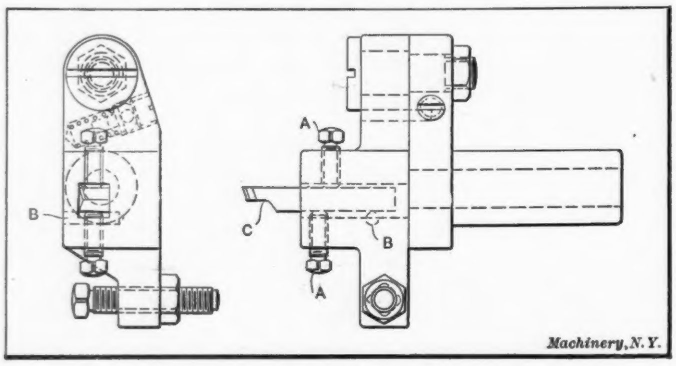


Fig. 23. Swing Tool used for Facing Operations

set-screws the tool can be set to the correct height, so that the objectionable teats can be removed with ease.

When making a cup-shaped piece of work similar to that shown in Fig. 24, usually the best procedure to follow, is to first drill, rough counterbore and form all at the same time. A rough counterbore can be used similar to that shown at B,

TABLE VI. FEEDS FOR FACING TOOLS MADE FROM HIGH-SPEED AND CARBON STEEL

(For Notation see Fig. 24)

Value of C	Brass Rod, Feed per Revolution	Machine Steel, Feed per Revolution	Tool Steel, Feed per Revolution
0.002-inch Chip			
12.0	0.0008	0.0007	0.0005
11.0	0.0010	0.0009	0.0007
10.0	0.0020	0.0015	0.0010
9.0	0.0030	0.0025	0.0015
8.0	0.0040	0.0030	0.0020
0.005-inch Chip			
7.0	0.0040	0.0030	0.0020
6.5	0.0050	0.0038	0.0022
6.0	0.0055	0.0040	0.0025
5.5	0.0060	0.0045	0.0028
5.0	0.0070	0.0050	0.0030
0.010-inch Chip			
4.5	0.0048	0.0030	0.0030
4.0	0.0050	0.0034	0.0034
3.5	0.0055	0.0037	0.0037
3.0	0.0060	0.0040	0.0040

Fig. 13 in the preceding installment of this article. Following the counterboring operation, a swing tool similar to that shown in Fig. 23 is used to square up the inside face which has become slightly concave, due to the heat generated between the side of the form tool and the work causing the work to spring away from the tool.

If it is necessary to have the back face of the piece square as well as the inside face, a revolving support can be used in the turret, following the rough counterboring operation or the first facing operation, as the case may be; preferably it should follow the facing operation. This support is used in conjunction with a shaving tool carried on either cross-slide, as may be necessary, and is brought up against the inside face of the work. The shaving tool is then fed across the back face of the work, taking a light shaving cut. If necessary it can also take a light cut off the shank, if it is desired to hold the diameter closer than 0.0015 inch. Care should be taken to have the spindle adjusted so that there is no end play, and to have the dwell on the cam uniform, because if the lobe for the revolving support is not uniform but has slight rises on it, it will produce an uneven finish on the back face of the work, thus defeating the object of the shaving operation.

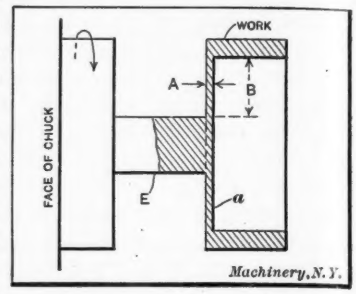


Fig. 24. Diagram giving Notation used in the Derivation of Feeds for Facing Operations

When the wall is very thin, that is when the distance B equals about ten times the dimension A, two facing cuts should be taken. It is also preferable when performing facing operations of this character to operate the swing tool from the front cross-slide and start the cut from the center of the work out to the full diameter.

Operating the swing tool from the front cross-slide permits the tool to be turned upside down (when the spindle is running forward) thus allowing the chips to be removed easily. Moreover when high periphery velocities are used on steel it is generally practicable to have the swing tool operated from the rear cross-slide or else run the spindle backward, so that a good supply of oil can reach the cutting edge of the tool.

Feeds for Facing Operations

The feeds and depths of chip for facing operations are given in Table VI. The values of C in the first column equal B di-

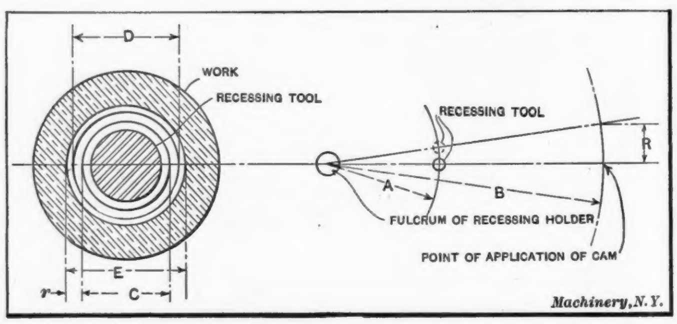


Fig. 25. Diagram for Finding Rise on Cross-slide Cam for Recessing and Chamfering Operations

vided by A (see Fig. 24). For example, assume that $B =$ 0.25 inch. Then when $A = 0.025$ inch, $C = \frac{0.250}{0.0250} = 10$, or in other words $B = 10$ times A.

It will be noted that the feeds given are approximately the same for brass rod and machine steel. This has been found satisfactory, as the resistance to the cutting pressure and the bending moment of the work approximately equals one another in cases of the materials mentioned. When the distance B is greater than 12 times A the form tool, or other means of supporting the thin wall against the pressure of the cut should be provided. Where the form tool is used for this purpose it should be made perfectly straight, that is, without side clearance, and it should be ground and lapped. In operation the form tool is dropped back from the shank E of the work to a distance about 0.010 inch and allowed to dwell in this position until the facing operation is completed. Care should be taken to have no end play in the spindle bearing when work of this description is being performed. A copious supply of good lard oil should also be supplied to the tools. The feeds under these conditions can sometimes exceed those given in Table VI, depending of course, upon the various materials being worked, depth of cut and the ratio of B to A.

Rise on Cross-slide Cam for Recessing and Chamfering

When using the recessing holders previously described it is obvious that the rise on the cam will be greater than the distance which the tool is fed into the work. To illustrate the method of finding the rise on the cam refer to Fig. 25, where

A = distance from center of the fulcrum to center of the recessing tool,

B = distance from center of fulcrum to point of application of cam or center of screw f (see Fig. 20),

C = diameter of recessing tool,

D = diameter of drilled hole in the work,

E = diameter of recessed hole,

r = travel of the recessing tool $= \frac{E-C}{2}$,

R = rise on the cam,

then $R : r :: B : A$. To illustrate this more clearly we will take a practical example. Let r equal 0.040 inch, B equal $2\frac{1}{4}$ inches, A equal $1\frac{1}{8}$ inch; then R equals $\frac{0.040 \times 2\frac{1}{4}}{1\frac{1}{8}} =$ 0.080 inch.

Care should be taken in setting the recessing tool to have it exactly in the center of the hole so that it will not strike the side when being forced into or backed out of the work.

Cam Lever Templets for Laying out Cams

In Fig. 26 are shown the cam lever templets for the Nos. 00, 0, 1 and 2 Brown & Sharpe automatic screw machines. These templets are used for laying out cams when it is necessary to have the starting or finishing points of the lobes on the cross-slide and lead cams in a certain definite relation to each other.

In operation these templets are used as follows: The center A as designated, is pivoted on the center of the cam by a pin or other pointed instrument which is inserted in the center hole provided in the lever. The main body of the templet B can then be rotated in any desired position so that the rolls of the cam levers can be set in their respective relations to each other. In this way the starting or finishing points of the lead and cross-slide cam lobes can very easily be obtained.

These cam lever templets are made from sheet celluloid, thus making them transparent so that any marks placed on the drawing can easily be detected, such as the location of the roll, whether on the top of the lobe, on the rise of the lobe or on the drop of it. The templets are manufactured by

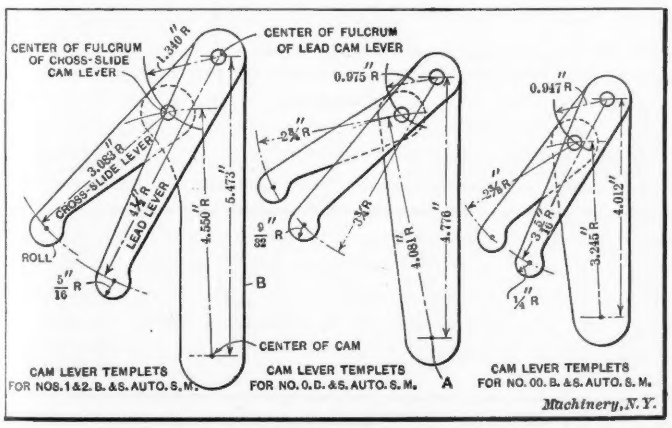


Fig. 26. Nos. 00, 0, 1 and 2, B. & S. Automatic Screw Machine Cam Lever Templets for Finding the Starting and Finishing Points of the Lobes for the Cross-slide and Lead Cams

the Brown & Sharpe Mfg. Co., Providence, R. I., and may be purchased from them.

Method of Laying out Cams for Chamfering

In Fig. 27 is shown a method for finding the starting and finishing points on the lobes of the cross slide and lead cams for chamfering. These points can very easily be obtained by means of the cam lever templets shown in Fig. 26. As was previously explained in regard to these templets the center A (see Fig. 26) is pivoted on the center of the cam.

There are two methods used in laying out a set of cams when it is necessary to obtain clearances or definite starting points for the lead and cross-slide lobes. The first one is to obtain a rough estimate of the total number of revolutions required to complete one piece, after which the revolutions are transferred into hundredths, and the location of the lobes laid out on the cam circles. Then the rises and drops are constructed and the amount of clearance obtained by the cam lever templets. This method usually requires considerable experience in this line of work, as an extra amount of work is necessary if sufficient clearance has not been allowed when making the rough estimate.

Another method and one which the writer considers superior to that given is to first find the rise on the cross-slide cam for chamfering (see Fig. 25). Then make a diagram as shown in Fig. 27. Circles should then be drawn representing the largest diameter of the lead cam, the largest diameter of the cross-slide cam, and the amount of rise on the cross-slide cam. It is obvious that, in chamfering operations, the tool should be located in the work before the cross-slide cam starts to operate on it. Therefore, the lead cam roll should be on the highest point of the lobe before the cam on the

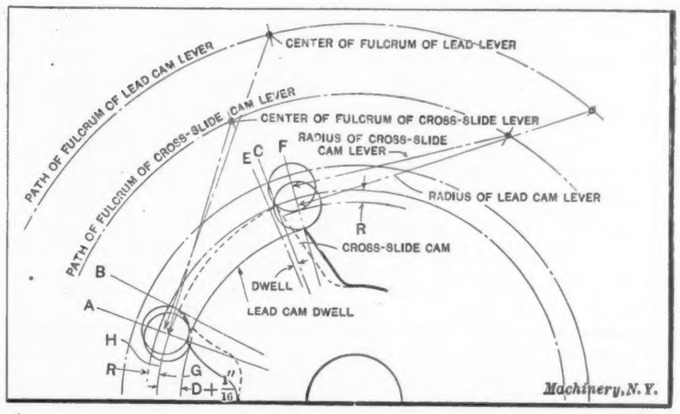


Fig. 27. Diagram for Finding the Starting and Finishing Points of the Lobes of the Cross-slide and Lead Cams for Chamfering Operations

cross slide used in forcing in the tool, touches the tool-holder. The circle, therefore, should be drawn representing the distance D (see also Fig. 17) and an amount added to it varying from 1/16 to 1/8 inch to allow for clearance. After the circles have been drawn, we can then find the starting and finishing points of the lobes.

The cam lever templet is now brought into position, and the lead cam roll placed so that its circumference touches the lobe on the lead cam and its center coincides with the hundredth line A. Then the cross-slide lever is swung down so that the circumference of the roll touches the circle G as shown, and with a sharp pencil a line is scribed around the circumference of the roll, which is to represent the quick rise of the cam. The compasses are then set to the desired radius for the quick rise of the cam which is described so that it will cut the circle H, representing the start of the rise on the cross-slide cam, and also cut the line which has been previously marked by scribing around the cross-slide lever roll. Where the quick rise of the cam and the circle R meet, will be the starting point of the rise on the cross-slide cam, or the hundredth line B as shown.

When we have found the starting points the next thing is to obtain the finish points of the lobe. It is obvious that the lead cam should hold the tool in position until the cross slide cam has dropped back an amount equal to the distance which it has forced the tool into the work or the rise on the cam. A hundredth line F is taken in any convenient position for the finish of the lead cam, and the cam lever templet is then brought into position so that the roll of the lead lever touches the circle and the center coincides with the line F as shown. The cross-slide roll is then swung down until its circumference touches the circle H and a mark is scribed around the circumference of the roll. Where this mark cuts the circle representing the largest diameter of the cam would be the finishing point of the lobe, that is, if the distance from the outside diameter was not exceedingly great or in other words not greater than the radius of the roll. If greater than this the drop should be constructed and where the mark representing the drop cuts the outside circle this will be the finishing point of the lobe, or the hundredth line C. The space from E to C represents from one to two revolutions for dwell on the cross-slide cam.

Now it can be clearly seen that the advantage of this method is that the amount of clearance between the starting and finishing points of the lead and cross-slide cams is known in hun-

dredths of the cam circle before the cams themselves are laid out, thus facilitating the operation of laying out the cams.

Methods of Laying out Cams for Recessing

In Fig. 28 a method is shown for finding the starting and finishing points on the lobes of the cross slide and lead cams for recessing. To determine these points the cam lever templets are again brought into operation. The starting point of the lead cam is first drawn and a circle is drawn equal to

TABLE VII. FEEDS FOR CHAMFERING TOOLS MADE FROM HIGH-SPEED AND CARBON STEELS

Diameter of Chamfering Tool in Inches	Brass Rod, Feed per Revolution	Machine Steel, Feed, per Revolution	Tool Steel, Feed per Revolution
1/8	0.0010	0.0008	0.0005
3/16	0.0015	0.0010	0.0008
1/4	0.0018	0.0015	0.0010
5/16	0.0020	0.0020	0.0012
3/8	0.0030	0.0022	0.0015
7/16	0.0040	0.0025	0.0018
1/2	0.0048	0.0030	0.0020
9/16	0.0055	0.0035	0.0021
5/8	0.0060	0.0038	0.0022
11/16	0.0065	0.0040	0.0024
3/4	0.0070	0.0045	0.0026
13/16	0.0075	0.0048	0.0028
7/8	0.0080	0.0050	0.0030

the distance K from the maximum diameter of the cam. Before this is done, of course, a maximum diameter of the cam should be obtained which will suit the length of the toolholder used in the turret. After this is found the various circles can be drawn representing the starting point of the rise on the cross-slide cam and also the distance K as before mentioned, when the cam lever templets are brought into operation and the lead roll is brought so that it touches the lead cam as shown and its center coincides with the hundredth line A. The rise on the cross-slide cam is laid off as was mentioned regarding the chamfering operations, and the distance $L + 1/16$ (see also Fig. 18) is also laid off. The cross-slide roll is then swung down until its circumference touches the line M as shown, and a mark made around its circumference as before described. The quick rise is then constructed and where it intersects the rise of the cam and the mark representing the circumference of the roll would be the starting point B on the cross-slide cam. The hundredth line C, which is to represent the finishing point of the rise on the cross-slide cam for feeding the tool in to take the desired chip, is then laid off and the cross-slide roll swung into position. The lead roll is then swung down until it touches the line as shown, and it will be seen that the starting point of the rise on the lead cam is slightly in advance of the finishing point on the cross-slide cam or the hundredth line D.

The finishing points of the lobes are the next things that require attention. Any hundredth line, as G, is taken at a convenient distance and the cam lever templets are then brought into operation. The lead roll is brought into the position shown, the cross-slide roll is swung down from the outside diameter of the cam equal to the distance R, and the drop laid off as before mentioned in regard to chamfering operations. The finishing point of the cross-slide lobe would then be on the hundredth line E. The space from C to E on the cross-slide cam would be for dwell, while the space from D to G on the lead cam would be the rise. The space from F to G is for dwell on the lead cam, which is about equal to one or two revolutions.

Speeds for Chamfering and Recessing Tools

The surface speeds used for recessing tools can be slightly greater than those used for counterbores on account of the light feeds and small amount of cutting surface in contact

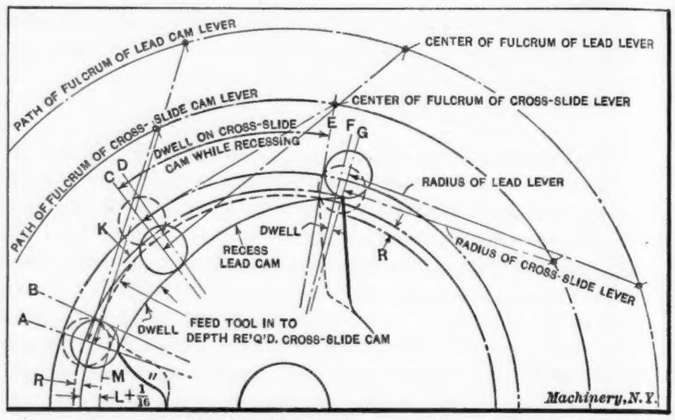


Fig. 28. Diagram for Finding the Starting and Finishing Points on the Lobes of the Cross-slide and Lead Cams for Recessing Operations

with the work. As a rule, the following surface speeds can be used on the materials specified with satisfactory results:

SPEEDS FOR RECESSING TOOLS MADE FROM CARBON STEEL

Material	Surface Speed in Feet per Minute
Brass (ordinary quality),	170-180
Gun screw iron,	60-70
Norway iron and machine steel,	45-55
Drill rod and tool steel,	35-40

TABLE VIII. FEEDS FOR RECESSING TOOLS MADE FROM HIGH-SPEED AND CARBON STEEL

0.010-inch Chip				1/32-inch Chip			
Diameter of Recessing Tool in Inches	Brass Rod, Feed per Revolution	Machine Steel, Feed per Revolution	Tool Steel, Feed per Revolution	Diameter of Recessing Tool in Inches	Brass Rod, Feed per Revolution	Machine Steel, Feed per Revolution	Tool Steel, Feed per Revolution
1/8	0.0020	0.0012	0.0010	3/8	0.0040	0.0025	0.0015
3/16	0.0030	0.0018	0.0015	7/16	0.0045	0.0030	0.0020
1/4	0.0040	0.0025	0.0020	1/2	0.0055	0.0040	0.0025
5/16	0.0080	0.0040	0.0040	9/16	0.0075	0.0050	0.0030
3/8	0.0120	0.0060	0.0050	5/8	0.0085	0.0060	0.0035
7/16	0.0160	0.0090	0.0060	11/16	0.0100	0.0065	0.0038
1/2	0.0200	0.0100	0.0070	3/4	0.0120	0.0070	0.0040
0.020-inch Chip				**1/16-inch Chip**			
1/4	0.0025	0.0015	0.0010	1/2	0.0030	0.0020	0.0010
5/16	0.0035	0.0020	0.0015	9/16	0.0040	0.0028	0.0015
3/8	0.0050	0.0030	0.0020	5/8	0.0050	0.0030	0.0020
7/16	0.0080	0.0050	0.0040	11/16	0.0060	0.0035	0.0023
1/2	0.0120	0.0070	0.0050	3/4	0.0075	0.0040	0.0025
9/16	0.0160	0.0090	0.0055	13/16	0.0080	0.0045	0.0028
5/8	0.0190	0.0100	0.0060	7/8	0.0085	0.0050	0.0030

SPEEDS FOR RECESSING TOOLS MADE FROM HIGH-SPEED STEEL

Material	Surface Speed in Feet per Minute
Brass (ordinary quality),	200-225
Gun screw iron,	90-100
Norway iron or machine steel,	75-85
Drill rod and tool steel,	50-60

Feeds for Chamfering

In Table VII are given the feeds to be used for chamfering tools when cutting the various materials and when the tools are of the diameters specified. It is obvious that the greater the length of the body of the tool in proportion to its diameter, the smaller will be the feed. This should be taken into consideration when using the feeds given. These feeds are

for chamfering tools having the proportions given in Figs. 17 to 19 inclusive.

Where the diameter of the body is smaller in proportion to its length than those previously given, it would be advisable in most cases to use a slightly decreased feed. No definite rule, however, can be given for this as the conditions vary so much. Therefore, the feed to be used will practically be a matter of judgment and can be found in no other way than by experience.

Feeds for Recessing

In Table VIII are given the feeds to be used when a chip from 0.010 to 1/16 inch thick is being removed. The same feeds as given in Table VII are used for feeding the recessing tool into the depth of chip required, while the feeds given in Table VIII are used for feeding the tool longitudinally into the depth required. As was previously mentioned regarding chamfering tools it is also necessary to take into consideration the length of the body of the tool in proportion to its diameter. This will govern to a considerable extent the feed to be used. For general conditions and for the recessing tools as made to the proportions given, the feeds in Table VIII will be found satisfactory.

In steel work especially it is usually found advisable to decrease the feed as the tool approaches the end of its cut when a chip varying from 1/32 to 1/16 inch thick is taken. This same rule is followed when a finish cut is taken with a box-tool up to a shoulder.

* * *

PROTAL—A NEW RUBBER SUBSTITUTE

The rapidly increasing price of rubber has greatly stimulated the activity of chemists to find a satisfactory substitute. The announcement therefore, of the discovery of a new compound with properties making it suitable for use as a rubber substitute has aroused considerable interest.

In 1844 Goodyear announced to the world his discovery that by the addition of sulphur and the agency of heat, there could be obtained from rubber, plastic, semi-plastic, and hard bodies suitable for use in the arts. This was the birth of a new industry. To-day there is invested in the rubber business approximately $150,000,000 of capital, and it employs 100,000 men.

Many compounds have been announced purporting to be satisfactory substitutes for rubber; but so far, none has had sufficient merit, apparently, to come into general use. Some valuable bodies have been found, such as celluloid, and certain shellac compounds. The composition of many of these substitutes is based upon the use of a body and a binder, the binder usually employed being some resin. The objection to resinous bodies is that they are readily oxidized, and then lose the binding property. They exaggerate the one great objection to the use of hard rubber in the arts, for, as is well known, hard rubber deteriorates rapidly when exposed to oxidizing influences.

In the announcement of the discovery of "protal," the inventor, Dr. F. G. Wiechmann states that the objections above stated have been overcome. The base of protal is a vegetable compound; it is vegetable-albumin derived from the seeds of certain South American palms. One variety especially, the Phytelepha Macrocarpa, produces hard, fine-grained seeds, so-called "taqua nuts." These have been used for almost a century in the production of buttons and sundry small articles. This base of vegetable-albumin, an admixture with an animal albumin and a suitable solvent, produces protal. Apparently a chemical compound has been found, for all the physical properties of protal, such as tensile strength, electrical resistance, and solubility, are different from those of the original constituents, and the new compound cannot be separated again by any known chemical process into its constituents. This material may be loaded with any materials commonly used in loading rubber; also with elastic bodies, resinous, or non-resinous including rubber.

When first produced protal is plastic, but soon acquires the hardness of stone; on rewarming, is becomes sufficiently plastic to be molded, taking sharp and clear impressions. It is odorless and resilient; it may be cut, sawed, filed, polished, drilled, tapped and countersunk, like hard wood. It may be colored by dyes and pigments incorporated with it. Heated in a flame it only chars and smolders. In some forms, protal is a good electric insulator; 134 protal compounds varied in mean dielectric strength from a minimum of 512 volts per millimeter, up to a maximum of 10,276 volts per millimeter. In tensile strength, pure protal compounds ranged from 1000 to 2110 pounds per square inch. Under compression tests of 100,000 pounds three samples showed no compression; two a compression of 8.3 per cent and four a compression of 16.7 per cent.

Protal compounds with asbestos, shellac, and resins are plastic and moldable, and some harden to stone when immersed in water. Protal compounded with linseed oil and pigments proves well adapted to make linoleum.

The most important limitation to the usefulness of some protal compounds is their susceptibility to the solvent influences of water and other chemical agents. The inventor at first tried to overcome this by incorporating a material designed to act as a coating and filler for the pores of the material. Resins were used for this purpose. These of course are open to the objection of oxidation and consequent deterioration. A way was found, however, of entirely obviating the difficulty by combining with protal another synthetic product, *viz.*, "baekelite." The latter body is the invention of Dr. L. H. Baekeland, of velox fame. It is a condensation product of phenol and formaldehyde, and apparently supplements perfectly the shortcomings of protal as mentioned above. The new material has been named protal-baekelite. This material like protal alone, may be combined with a great variety of substances. For example, to produce insulators, mica and asbestos may be incorporated; where the material is to be molded, it may be combined with paper pulp, wood flour, cellulose, etc.

Among the properties claimed we note a specific gravity of about 1.36, tensile strength 2000 pounds per square inch; crushing strength over 60,000 pounds per square inch. On immersion in water, steam, machine oil, cylinder oil, acetone, alcohol, sulphuric acid, acetic acid, turpentine, benzine and dilute solutions of sodium carbonate and ammon-hydrate, this material shows absolute indifference to these reagents.

Protal compounds are made by the American Protal Co., 24 State St., New York. The information of the preceding article is taken from a paper read by the inventor of protal before the American Institute of Chemical Engineers at its Niagara meeting, June 22, 1910.

* Abstract by Dr. H. M. Goettsch, assistant professor of technical chemistry, University of Cincinnati, Cincinnati, Ohio.

* * *

Maine is the chief center of the spool manufacture. Its factories turn out 800,000,000 spools yearly, chiefly birch. Few woods as hard as this can be worked with as little dulling of the tools; its principal recommendation lies in that fact. It is handsome in color, and, after the wood becomes seasoned, it shrinks and warps very little. That is also an important consideration, because the delicate machinery that winds the thread would fail to work if the spool changed its shape to a perceptible degree. The birch wood for spools must be selected and handled with care. The tree's red disk heartwood is objectionable because it will not turn smooth in the lathe, and the color is not desired. Few industries waste more wood, in proportion to the quantity used, than spool making. Heartwood, knots, and all other defects, frequently amounting to more than one-half of the tree, are rejected. From one-half to three-fourths of the remainder may go to the refuse heap in sawing the bars and turning the spools.

* * *

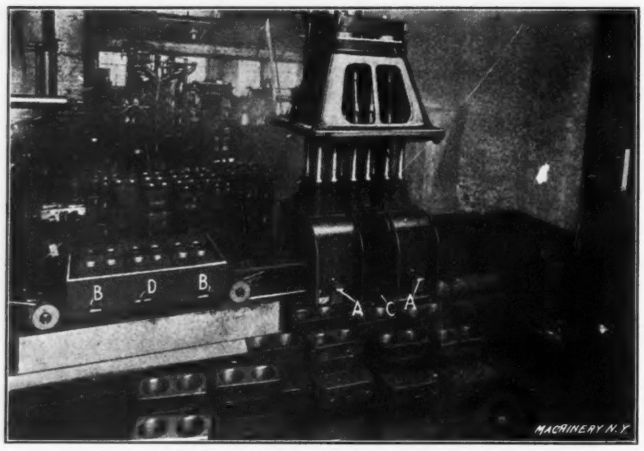
The name on steel knife blades is etched on the surface by means of the rubber-stamp method. The surface is coated with gumguaiacum-varnish. The rubber-stamp coated with a thin layer of potash solution, is then stamped on which removes the varnish leaving the steel free to be etched by dilute nitric acid. The rubber-stamp method is the cheapest of any of the processes.—*Brass World.*

LETTERS ON PRACTICAL SUBJECTS

We pay only for articles published exclusively in MACHINERY.

BORING AUTOMOBILE CYLINDERS

The accompanying engraving shows a Pratt & Whitney multiple-spindle drilling machine used in one of the large automobile shops for boring out six pairs, or twelve, cylinders at one time. The jigs for holding the units are mounted on

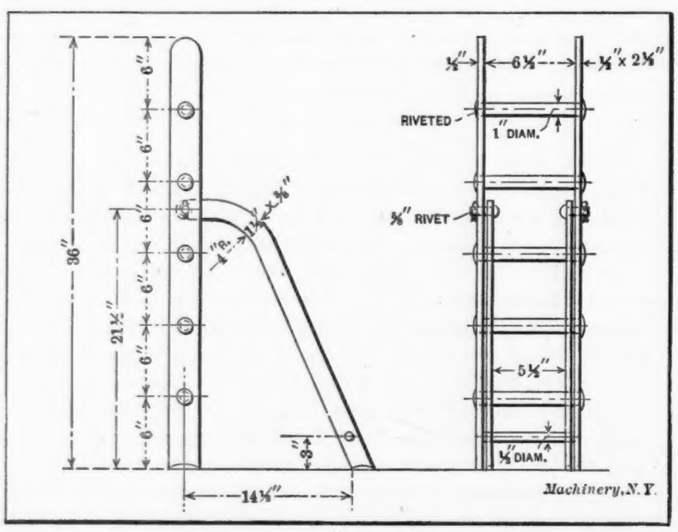


Boring Twelve Cylinders at one time in a Pratt & Whitney Multiple-spindle Drilling Machine

rollers and run on a track, so that they are easily handled, one jig being emptied and loaded again while the other is in the machine, making the boring operation practically continuous. When the jig is in position in the machine it is held in place by the straps *A*, which fit in the slots *B* in the jig. The plunger *C* locates the jig in the correct relation to the spindles, fitting in the slot *D*. The cylinder castings are held to the jig base-plate by bolts passing through the holes which are used in fastening the cylinders to the crank-case. E. V.

FULCRUM STAND FOR THE RAILWAY SHOP

As those familiar with locomotive work know, one of the operations connected with "wheeling" an engine consists of putting up and bolting to the frame the pedestal braces or binders, which are attached to the frame jaws beneath the



Device used as a Fulcrum when Erecting Binders or Pedestal Braces

driving boxes. The wheels are, of course, first placed in position, after which the binders are put up. Three men are usually employed for this work, two being beneath the engine to raise the binder and wedge while the third man outside supports it by a bar, thrust between the spokes of the driving wheel. As soon as the binder is caught by the bar, it is pried up far enough to permit entering nuts on the binder bolts. Ordinarily, a jacking block is used as a fulcrum for this bar, but such blocks are heavy and cumbersome so that moving them from one wheel to another is not only laborious work but consumes unnecessary time. A substitute for these blocks which is both light and convenient to handle, is shown in the accompanying engraving. This device is in the form of a ladder, the rungs of which give fulcrums of various heights. The sides are made of 2½ by ½ inch flat iron and these are held together by five rings, 1 inch in diameter, that are riveted over at the ends. A pivoted support keeps the stand in an upright position when in use. The advantages which this stand has over the old method can only be fully appreciated by those who have had to carry the heavy wooden jacking blocks from one wheel to another and from one side of the engine to the other. CHARLES H. WEEKS

Elizabethport, N. J.

MAKING ADDING MACHINE STOPS

The manufacture of the sheet-metal stop shown in Fig. 1 was at one time considered by the management of an adding machine company a serious problem, as one hundred of these pieces are used on each machine.

As great accuracy was necessary in making the stops, the usual precautions were observed. *i. e.*, the piece was blanked,

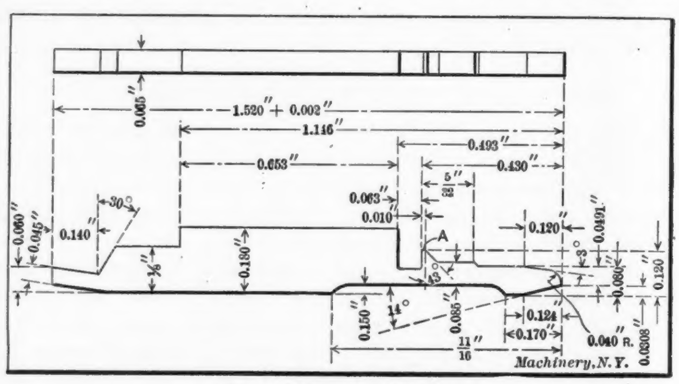


Fig. 1. Adding Machine Stop

flattened and shaved with good tools, but it was found impossible to maintain an accurate point at *A* (see Figs. 1 and 3). This point would turn over and have a rounded appearance and also a bad break, which was detrimental, as this same point was a working face. Therefore, the production by die work was abandoned and the method shown in Fig. 2 was tried.

This scheme consisted in milling with form cutters, six strips of steel at one time. The strips were held by flat

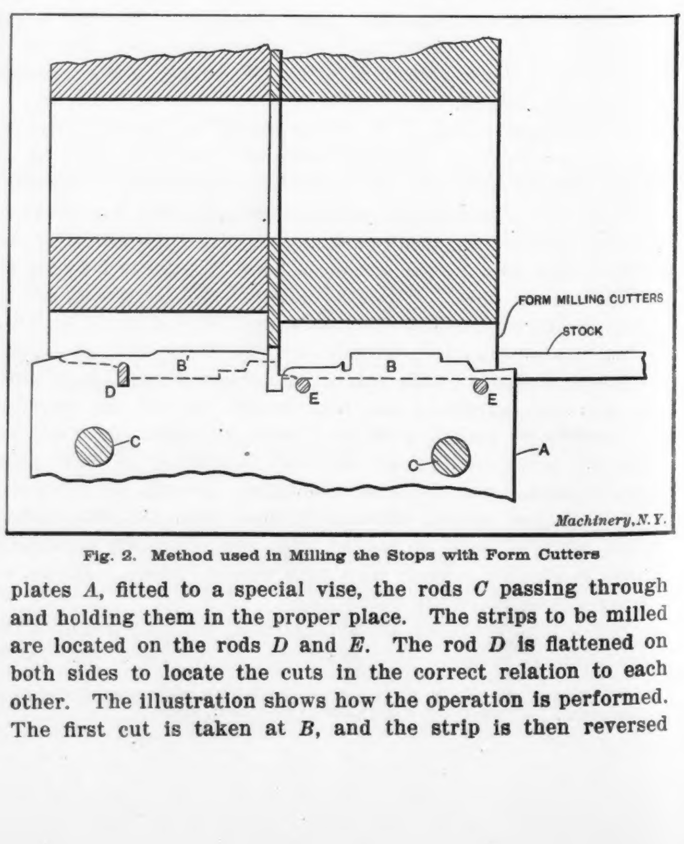


Fig. 2. Method used in Milling the Stops with Form Cutters

plates *A*, fitted to a special vise, the rods *C* passing through and holding them in the proper place. The strips to be milled are located on the rods *D* and *E*. The rod *D* is flattened on both sides to locate the cuts in the correct relation to each other. The illustration shows how the operation is performed. The first cut is taken at *B*, and the strip is then reversed

and carried forward; then a cut is taken at *B'* and at the same time the stop is cut off to the desired length, thus completing it. This method also proved to be a failure, as only about 50 per cent of the pieces were accurate and the operation was very slow. In addition, the upkeep of the fixture—grinding form cutters to correct diameters, etc.,—made the cost of production prohibitive.

At the writer's suggestion the method shown in Figs. 3, 4 and 5 was resorted to and finally solved the problem. The

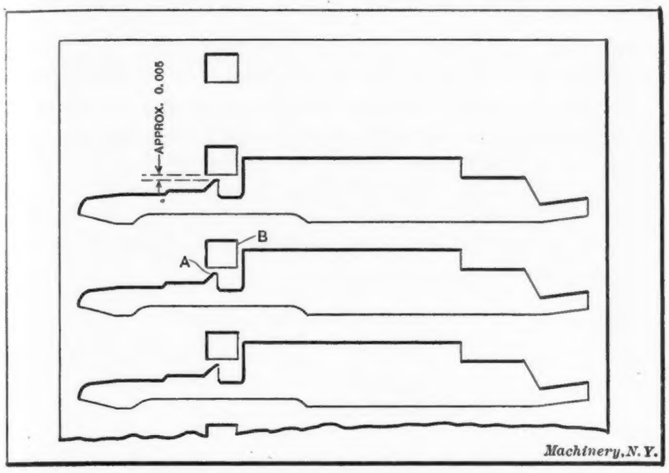


Fig. 3. Condition of Scrap as it comes from the Blanking Die

idea in preserving the point mentioned is clearly illustrated at *A* in Fig. 3. The scrap is here shown as it comes from the blanking die. A small section is cut out of the stock at *B*, leaving enough metal around *A* so that when the punch pierces the stock the resistance is very little—hence a clean cut and no break at the point.

A plan and a sectional view of the die are shown in Fig. 4. The die *A* is made in two parts fastened together with screws. *B* is the guide plate. The stripper *C* is on the punch and is

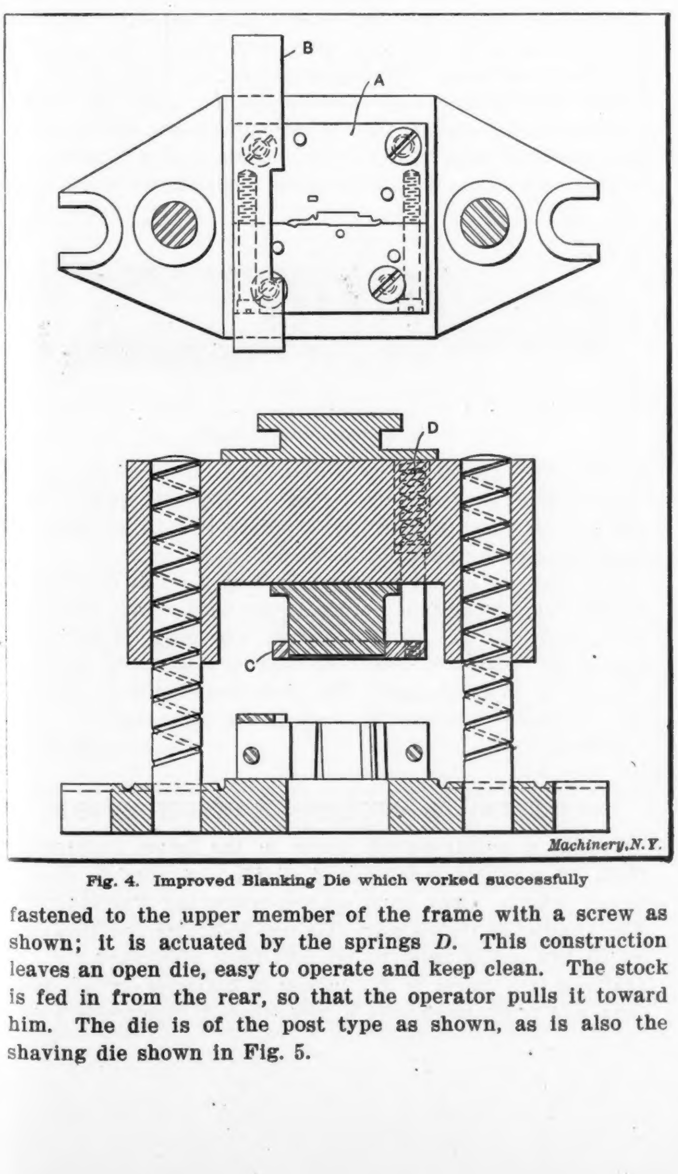


Fig. 4. Improved Blanking Die which worked successfully

fastened to the upper member of the frame with a screw as shown; it is actuated by the springs *D*. This construction leaves an open die, easy to operate and keep clean. The stock is fed in from the rear, so that the operator pulls it toward him. The die is of the post type as shown, as is also the shaving die shown in Fig. 5.

In the shaving die shown in Fig. 5, the blank is placed in the swinging nest in the upper part of the engraving. This nest has a bushing *B* inserted in it which is hinged or swings on the post *A*. A bushing *D* is fastened in the nest and as the punch descends the pilot *C* enters into it, and locates the nest in the correct position relative to the punch and die. The blank is ejected by the shedder *E*, actuated by the springs *S*. The construction of the shaving die is shown plainly and needs no further explanation. A. C. Lindholm

New Haven, Conn.

LEVELING A HEAVY LATHE

"I chanced to be passing our testing floor just as the head inspector was going over the 42 inch lathe recently shipped to the X. Y. Z. Railroad Co.," the trouble man was saying on his return from a recent trip, "and as a matter of curiosity stopped to see how the alignment was on that particular machine. The tail spindle measured 0.002 inch high and the

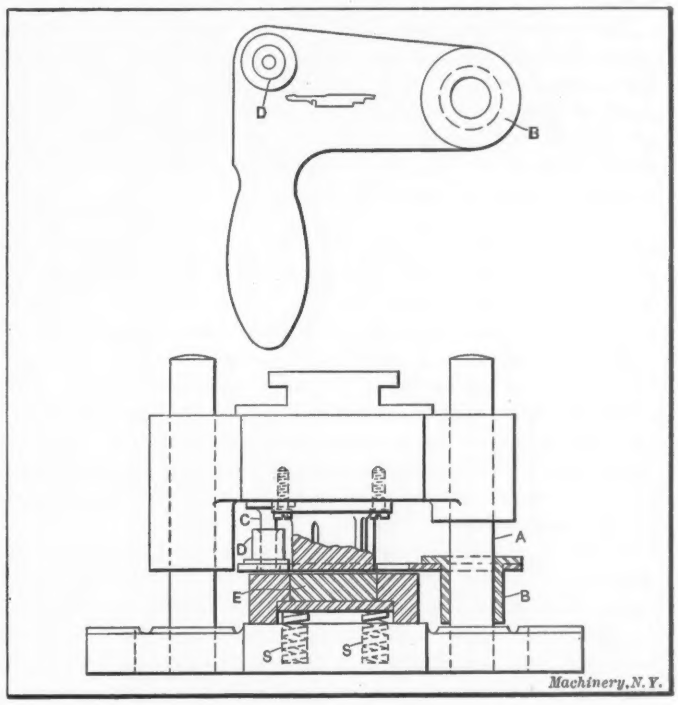


Fig. 5. Shaving Die used for Finishing the Stops

indicator with a 36 inch test bar, showed that the head and tail spindles were in perfect alignment.

"You can therefore imagine my surprise when, some two weeks later, the master mechanic of that road called me up on the long distance 'phone and said that he was trying to bore the hub of a 42 inch car-wheel on this new lathe, and that the best he could do was to get a hole which was 0.011 inch small at one end in a hub only 4 inches long. I asked him if his boring-tool had not sprung; he was sure it had not. I then asked him if the lathe was level; he was sure it was, as he had seen that attended to very carefully. Apparently it was necessary for me to go and try to straighten out the matter.

"When I went to the shop the next morning I found the lathe resting on wooden wedges. The floor was of boards laid on top of concrete. The machine looked rather shaky.

"I asked the master mechanic if he would get his level so that we could test the leveling at all points of the bed. He brought a carpenter's level and laid it across the V's. Just as he expected, it showed that the machine apparently was set all right. Fortunately I had a sensitive level with me and laid my own alongside of his. In my level the bubble was not even visible in the glass, so badly was the bed out of level. I then showed the master mechanic that it was possible to raise one end of his level a full one-quarter inch without making an appreciable difference in the location of the bubble.

"Then I had the blacksmith make a number of wide iron wedges; we moved the lathe to one side and took up the floor

where the machine was to stand so as to get down to the concrete bottom, laid 2 inch by 4 inch timbers on the concrete with the iron wedges spaced at intervals along the timbers, and placed the lathe on top of these wedges. It was then a simple matter with the sensitive level to set the bed perfectly level both across the V's and lengthwise of the bed. Having done this, I had a batch of concrete mixed up and poured into the space enclosed by the 2 inch by 4 inch timbers underneath the lathe. This gave an absolutely solid foundation right up to the bottom of the bed.

"We let the cement set over night and the next morning I again tried the level on the machine. There had been no change and the setting was perfect. I then told the machinist to put in the car-wheel and bore the hub again; he did so and on trying the hole with internal micrometers, could not find a particle of difference in diameter at the front and back." H. M. WOOD

Cincinnati, Ohio.

SQUARE VS. SPLINED CHANGE-GEAR SHAFTS

The writer has read with interest the article in the October number, engineering edition, on the design of automobile transmission gears by Mr. M. Terry, and while from a point of general information this article is valuable, yet there are certain conclusions reached by the author, which, had a more detailed consideration been given to them, would probably have resulted differently.

Referring particularly to the discussion of the advantages of the square and spline shafts for sliding gears he arrives at the apparent conclusion that of the two the square shaft possesses greater advantages than does the spline, hence we would be led to believe that the undoubted preference which he himself states to exist among automobile users as well as manufacturers for the spline shaft, is but a whim and that no real advantage accrues to the purchaser or user of this, and that its use degenerates to the mere "talking point" of the salesman. There are, however, certain technical considerations entering into the matter, which have caused many manufacturers to use the more expensive construction.

In the first instance, as he himself stated, the resisting moment of the spline shaft is, as a rule, greater than that of the square occupying the same space. It is true that the splines on the shaft must resist shearing stresses. This, however, need not be a condemnation of their use as they can readily be made of a sufficient circumferential width to easily withstand the same. To offset this shear there is the advantage that in the spline shaft the torsional forces are tangential and induce shearing only in the gear hub while with the square shaft these forces are largely deflected from a tangential toward the radial in the gear hub, tending to burst the hub and thus finally to enlarge the hole. This enlargement in actual practice proceeds rapidly until the usefulness of the gear is destroyed owing to its wobbling on its shaft and producing that undesirable concomitant of the ancient motor car and the bane of all careful manufacturers—noise.

Granting that both types of shafts are casehardened, it may be true that the square shaft is more cheaply ground, but of what avail is this when the gears sliding on it are also casehardened, and how is it proposed to overcome the distortion of the square hole? It cannot be ground. [?] Hence this can be overcome in only one way, that is, to allow sufficient tolerance in this hole so that the gear will slide fairly well and possibly hit some spots on its shaft. Reverting to the spline shaft, the tops of the splines are easily ground, but that this shaft can be ground only there is not true, for the writer knows of at least one manufacturer of thousands of these shafts with integral splines, every one of which is ground to a cylindrical surface between the splines. As for the gears sliding on this type of shaft owing to the circular hole therein, even though they do distort in hardening, it is possible, and indeed common practice, to grind the bore; hence, we find in the transmission assembly in which the spline shaft and the sliding gears have been treated in the above manner, gears that at the outset and for all time are accurately centered and closely fit their shafts; gears that run true and never wobble; gears that always slide easily because the hubs thereof are not distorted by any ill-disposed line of pressure and are as quiet in their second year of running as in their first.

Thus we see that the preference of the buying public for the spline shaft gear set is not based on our author's "talking point," but is backed by their experience with noisy second-year square shaft transmissions and moreover by sound technical logic. FREDERICK HUGHES

Sharon, Pa.

MILLING FIXTURE FOR CUTTING WORMS

In Fig. 1 is shown a simple fixture for cutting worms in the milling machine. The body *A* of the fixture is made from cast iron and is held in the vise of the machine. A hole is bored through the casting *A*, a bushing *B* is inserted in one end, and shaft *C* having a thread the same pitch as the worm to be cut is screwed into this bushing. The handwheel *D* is

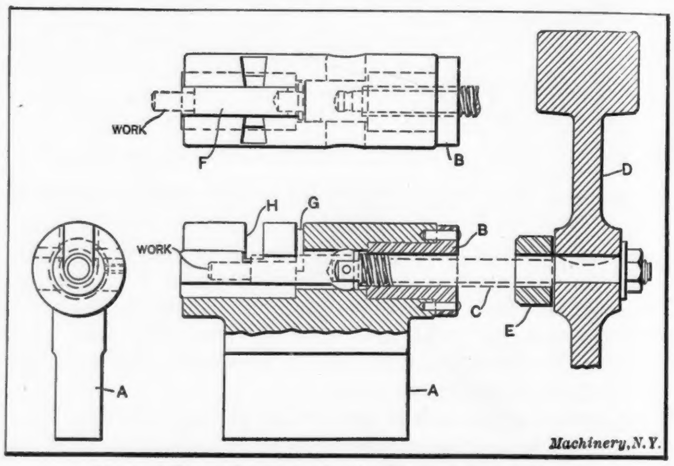


Fig. 1. Milling Fixture for Cutting Worm shown in Fig. 2

fastened onto the end of the shaft *C* and held with a key and nut. A washer *E* acts as a stop, determining the length of the thread to be cut. The piece to be cut is shown by the dotted lines in the lower view in position where the milling cutter starts to operate; and in the upper view it is shown in position at the end of the stroke. Slots *F* and *G* are cut in the top part of the fixture to allow the work to be easily re-

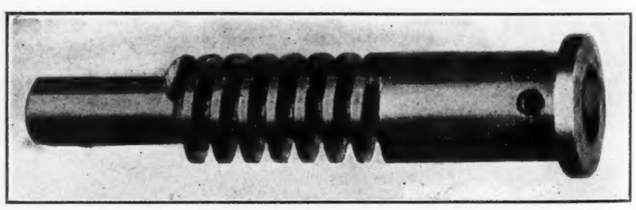


Fig. 2. Worm to be milled

moved. The slot *H* is cut at an angle to clear the milling cutter when the fixture is set at the required angle. When cutting the worm, the milling vise is set off at an angle corresponding to the pitch of the worm.

The worm to be cut is shown in Fig. 2. The finish is not all that could be desired, but the cutter used was 3/8 inch pitch. If good results are to be expected, the pitch of the cutter should not be greater than 5/32 inch on a worm of this diameter which is 0.620 inch. The feed also should be slight as this method of holding the work is not very rigid.

Buffalo, N. Y. CHARLES WESLOW

CUTTING A MULTIPLE-PITCH WORM

To cut a multiple-pitch worm in the lathe, multiply the pitch by a whole number and divide the number thus obtained into as many parts as the worm has starting points. The number of inches thus obtained indicates the distance to which the saddle must be brought back after each cut. For example, if a worm is 3½ inches in diameter by 4½ inches long, and is 2⅝ pitch with a triple thread, then 2⅝ x 8 = 21,

and $\frac{21}{3} = 7$. Now to cut the worm, take the first cut, stop the lathe and bring the saddle back 7 inches. Engage the nut on the lead-screw and take the second cut, and so on until the worm is finished. If the worm were 11 inches long, then the distance would be double so that it would insure the tool coming clear of the end of the worm for each cut. If the worm had a double thread, then the distance to which the carriage must be brought back for each cut would equal $\frac{21}{2} =$ 10½ inches. This has been found a quicker and more accurate method than by marking the gears. S. H. C.

ADAPTERS FOR HOLDING LARGE THIN WASHERS WHILE TURNING

The large washer shown in Fig. 1, 6½ inches diameter, was first blanked out in a punch press, but as this left a ragged edge and did not give the desired finish, it was deemed advisable to turn the external and internal diameter. For this operation two adapters were made, as shown in Figs. 2 and 3, which were found to be very satisfactory. These adapters were threaded in the rear end to fit on the nose of the spindle of a No. 6, Warner & Swasey turret screw machine. Of course, it is obvious that the same design of adapters could be used on any screw machine having a wire feed by simply changing the thread in the rear end to suit the nose of the spindle. These adapters have a great advantage over the ordinary chuck owing to the fact that no wrenches are required to tighten the work in them as the work is tightened by means of the sleeve passing through the spindle which operates the spring collet. The amount left on the outside and inside diameters of the rings for finish turning in the screw machine was 1/32 inch, which was found sufficient to true them up and give them a good finish, it only being necessary to take one cut inside and out.

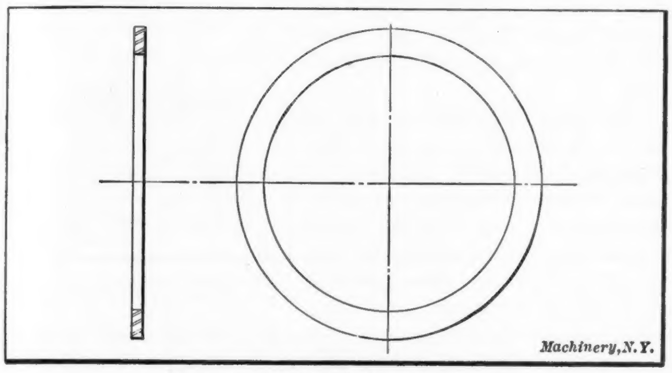


Fig. 1. Large Thin Washer to be turned

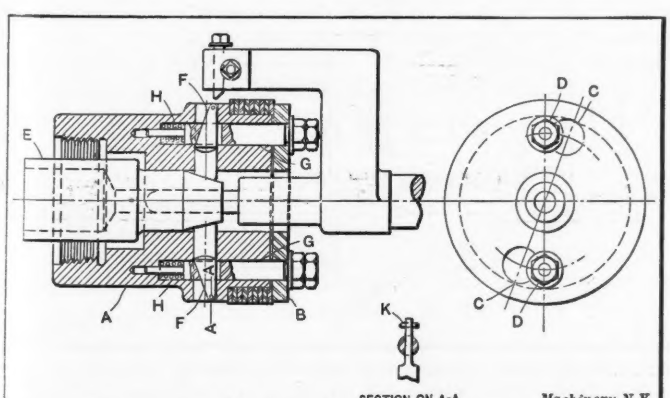


Fig. 2. Adapter used in Holding the Washers while Turning their External Diameters

The body *A* of the adapter Fig. 2 is made of cast iron, finished all over and drilled and reamed as shown. The clamp *B* which holds nine of the rings in place is made of machine steel, and the holes *C* are drilled large enough to pass over the lock-nuts *D*. The hole *C* is elongated so that it can be locked under the lock-nuts simply by turning the plate *B* to the left. The plunger *E* is of tool steel, hardened and ground on the outside diameter, and the hole for the leader of the turning tool is also ground concentric with the outside diameter. The plunger is bored out large in diameter at the back to reduce its weight, and is made a sliding fit in the casting *A*. The operating and locking pins *F* and *G* are made of machine steel and casehardened. *G* has a slot through its center similar to that shown in section *AA*. The rear end of the slot has the same angle as the edge of the operating pin *F* which passes through it. The small pin *K* shown in the top end of the operating pin *F*, prevents it from dropping out when the plunger *E* is removed. The first operation on the rings is to remove 1/32 inch from the outside diameter in the adapter shown in Fig. 2. Nine rings are placed in this adapter as shown. The clamp *B* is put on by placing the large holes *C* over the nuts; then by turning the plate to the left it is locked underneath the lock-nuts *D*. To clamp the rings in the adapter proceed as follows: After loading and placing the clamp *B* in position trip the lever, which operates the closing of the chuck by forcing the sleeve in the spindle forward. This comes in contact with plunger *E* which, in turn, forces the clamp pins *F* outward, thus drawing back the clamping bolts *G*. After the cut is taken, the lever for opening the chuck is again operated and the small coil spring *H* forces the clamping bolts *G* outward, thus releasing the pressure on plate *B*, when it can be easily removed. This finishes the first operation, after which the rings are ready to be finished inside.

The adapter for holding the rings while turning the inside is shown in Fig. 3, and is constructed somewhat similarly to that just described, with the exception that it is bored out to receive the rings. The method of opening and closing this adapter is similar to that shown in Fig. 2, but the cap *B* is removed by pulling it out instead of twisting it around to bring it over the nuts. A tool-holder with a leader, not shown in the illustration, is also used for the second operation on the rings. RALPH E. MCCOY

Cleveland, Ohio.

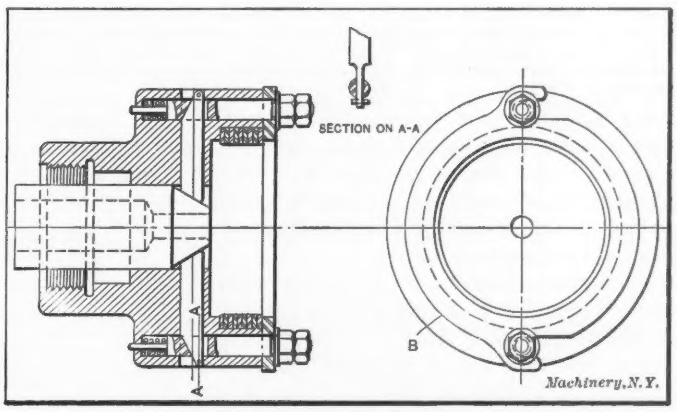


Fig. 3. Adapter used in Holding the Washers while Turning their Internal Diameters

SPACING THE CUTTING EDGES OF REAMERS

In the August number of MACHINERY there was an editorial note asking for information regarding the irregular spacing and the spiral fluting of reamers. In regard to this the writer would say, that the first and possibly the more common method is to stagger the flutes in pairs, and the second method is to stagger the flutes all but one pair, using this pair to measure up by. The best method to prevent chattering where a suitable measuring instrument can be obtained, is to make the reamer with an odd number of flutes, generally 5, 7, 9 and 11, the number of flutes depending, of course, on the size of the reamer; but this method involves difficult measuring. As regards the spiral fluting, there is very little advantage to be gained except in the case of taper reamers, but as the conditions under which a reamer is used govern to a considerable extent the spiral to be given, no definite rule

can be given for this. It is safe to say, however, that in nearly all cases the spiral should be left-handed, especially if they are to be used for machining, otherwise they will bite into the work and cause considerable trouble. For large taper hand reamers which are used in cast iron, especially where the taper is very great (over 2½ inches per foot), a right-hand spiral will make it much easier for the man who is doing the pushing. If reamers are to be used on all classes of work, the writer would much prefer to cut them central or radial, though it is much better practice to give a negative rake for brass and a positive rake for steel, while for cast iron a reamer cut radial will give better results.

H. M.

DEVICE FOR FACING MITER AND BEVEL GEARS

In one of the largest factories in the Middle West small gears are roughed out in large quantities in an automatic machine, and have to be sized correctly in a lathe, that is bringing the peak in the correct relation to the face, before cutting the teeth. This ordinarily requires careful work and also a frequent use of the gage, and even then a gear is frequently turned too thin, as expert workmen cannot be employed on this class of machining, apprentice boys usually getting the job.

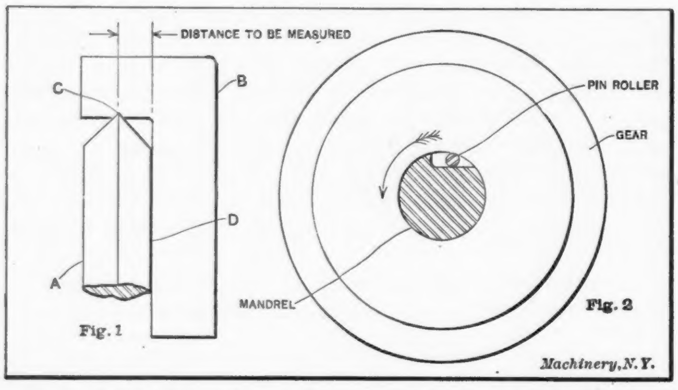


Fig. 1. Method of Measuring the Distance from the Peak to the Side of the Gear

Fig. 2. Cross-section of Pin-roller Mandrel showing how Gear is locked by the Roller

The type of gage used and its application is shown in Fig. 1, *A* representing the gear; *B* the gage, and *C* and *D* the parts to be gaged, while in Fig. 3 is shown the device used to do away with the too frequent use of the gage. It must, of course, be understood that only a single cut is taken across the outer side in this operation. The attachment used on the lathe cross-slide to correctly locate the tool is shown in detail in the upper part of the engraving, and in the lower part in position on the cross-slide. In the detail view *A* is a cast-iron clamp wide enough to fit easily over the cross-slide; *B* is a post made of cold-rolled steel, which is drilled and tapped as shown, and *C* is a strip of sheet steel, in the end of which a notch has been filed corresponding to the shape and angle of the outside of the gear blank. In using this attachment, a gear blank is first placed on a pin-roller mandrel, a cross-section of which is shown in Fig. 2, and up against a collar as shown in Fig. 3; when it is carefully faced off correctly by measuring the distance from the peak to the side with the standard gage shown in Fig. 1, the templet *C* is run up to the blank as shown and the tool set so as to just skim the surface previously faced, which insures the proper relation between the cutting tool and the notch in the templet. After this all that is necessary is to place the gear blanks on the mandrel tight against the collar, as the tool has been correctly located by setting the templet, and then all the gears are faced off on one side. The mandrel is made small on the outer end so that the cut may be run completely across the side. After all of the blanks have been surfaced off on one side they are again placed on the mandrel with the finished side next to the collar and the carriage stop *D* is used to retain the correct distance for the total thickness after the tool has been set from a finished gear blank.

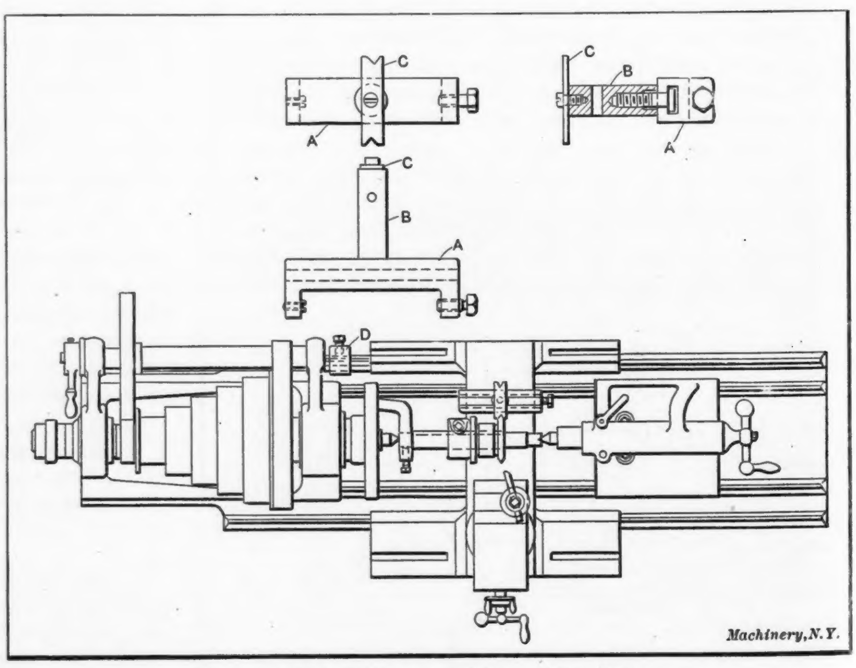


Fig. 3. Method used in Facing Miter and Bevel Gears

A stub-roller mandrel and collar could be used in some cases to better advantage than the one shown.

Cincinnati, Ohio. J. E. EMIG

PERTINENT POINTS ON JIG AND FIXTURE DESIGN

Under this heading in the October number of MACHINERY is a criticism of an article which appeared in the August number.

As far as any rule, guide, standard or system in regard to bushings is concerned, the only one to follow is "horse sense." Theory does not work out in practice in all cases, and methods, like everything else, change locally to such an extent that there is no hard and fast rule which can be laid down. By changing around from one shop to another, you find that certain methods which are called impractical in one place, are used with success in another place.

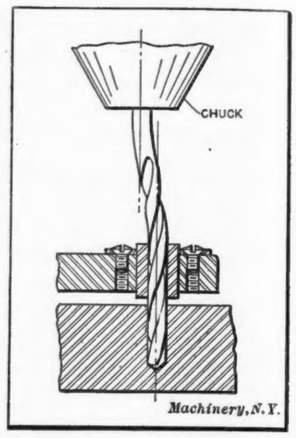


Illustration showing how Drill is straightened by the Drill Bushing

The length and style of bushing has to fit the particular case. For example, you would not use the same length of bushing for a No. 60 drill, in a jig weighing a few ounces that you would in one weighing two or three pounds. With the small jig, the drill could move the jig into line, and a short bushing would answer very well, but with the larger jig, the bushing would naturally have to be longer.

As the writer sees it, the length of a bushing does not have much to do with a drill drilling true, but it should have length for wear. The drill is held in the chuck at one end, and the bushing guides the other. If the hole in the bushing is not in line, of course it deflects the drill, but when the drill is once entered, the bushing will straighten it up, that is, the part that is in the bushing, as shown in the accompanying illustration. It is the same as a plug in a hole. It is impossible to cramp a plug that fits a hole, and the high speed of a drill serves the same purpose.

As regards the clearance between the bushing and the work, this is also a matter of choice. In cast iron, the chips

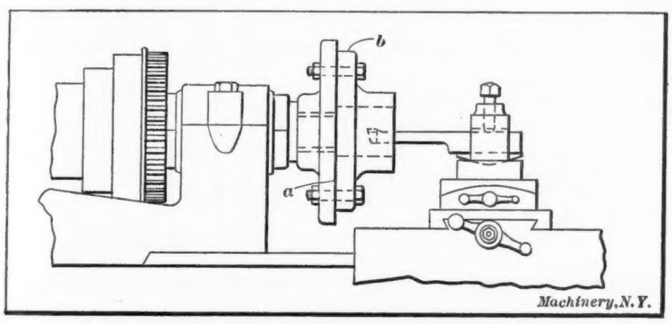
will crumble away under a bushing very close to the work, but in steel the longer chips are apt to give trouble. In many shops the bushings are made with a head on the inside of the jig to serve as a support for the piece to be drilled, which is good practice in several ways. It makes small bearing points to keep clean, the chips follow the drill grooves and never clog, and it means that the hole must start accurately. This method is only used when the piece to be drilled has a smooth face which comes in contact with the bushing.

The question of heads to prevent drilling holes in the jig, is another one that has its different points. Mr. T. Covey says that the man who drills holes in the jig cover or lid should be discharged. This is all very true, but let Mr. Covey work in a part of the country where press hands are as scarce as "hen's teeth" and you have to educate all your help or else import them from another part of the state, and if this were followed up, he would soon close up shop.

A method which is cheaper and better than using a head on the bushing is to make the bushing just a plain straight one and use a plate of 1/32 inch machine steel pack-hardened, to protect the jig. This plate is screwed on with small flush-head screws. The advantage is a cheaper bushing, and by stamping the drill size on the plate, in case the size is changed the plate can easily be replaced, while if stamped into the jig you have to cut out the marking, providing, of course, that it is not already drilled out by the operator. C. A. T.

BORING AND TURNING A CHUCK PLATE CASTING

In the Shop Operation Supplement of MACHINERY, September, 1910, with reference to boring and turning a chuck plate casting in the lathe, it was shown that the casting was held in a three-jawed chuck. This the writer does not consider the best method of doing the operation, as he has done the same



Improved Method of Machining a Chuck-plate Casting

job several times in this way, and found it both slow and tedious. Usually the job is done on the lathe to which the chuck plate is fitted. Every time it had to be tried on the spindle, it was necessary to take the chuck off with the plate in it, reverse it, and hold it on the arm, which was a very tiresome and tedious operation, and there was also danger of the plate shifting in the chuck, owing to its weight. When the chuck was taken off and replaced the unfinished thread in the chuck plate did not always run true, which resulted in a poor job.

An improved method of machining a chuck plate casting is shown in the accompanying illustration. Here the chuck plate is bolted to the dog or driving plate of the lathe instead of being held in the chuck. The machining of the chuck plate is as follows: First the chuck plate is set up in the chuck and a roughing cut taken across the face *a*, and also the edge *b*. A line is then "spotted" with the tool on the face of the casting, the same size in diameter as the diametral distance between the centers of the bolt holes in the chuck which the plate is to fit. When this is completed the chuck plate is taken out and fastened onto the dog plate as shown, the bolts passing through the holes which were previously drilled in the plate. The weight of the dog plate is comparatively trifling and it usually runs true when replaced. The chuck plate is trued up on the dog plate by the outside diameter *b*. The remainder of the work, after the inside is bored and threaded, is turned in the usual way on the lathe spindle.

New York. H. ROBINSON

DIMENSIONING DRAWINGS

The writer offers the opinion that the article in the October number of MACHINERY entitled "Improved Method of Dimensioning Jigs and Fixtures," by Jig and Tool Designer, is very misleading to say the least.

It is stated therein that some dimensions are important to 0.0005 inch and to meet other conditions must be indicated from an established hole, surface or line while others are near enough if laid out with the ordinary tools. To mix up such dimensions on a drawing is to force the toolmaker to spend much more time on a piece of work than the requirements demand. If all dimensions are given from the center lines the only way to distinguish between those intended to be correct and those approximate is to give the former as decimals and the latter as common fractions. This seems absurd because on a milling machine with correct screws it is just as easy to get a measurement accurate as approximate.

Now suppose a hole is located 2.603 inches on the left of the vertical center line and the next hole in the series of operations is 1.937 inch to the right of the center line, it is safer to give one dimension as the total distance between the holes than to leave the addition to the workman, for they must be added in some manner to get from one side of the center to the other. This would be especially true if there was no milling machine in the tool-room and the work had to be done on a lathe, for on a lathe it would be imperative that dimensions be given from one hole to the next. To one familiar with indicating on a faceplate the truth of the above statement will be readily apparent. In making drawings, the shop equipment must be taken into consideration.

The writer feels safe in saying that to get accurate results on small automatic machinery it is many times absolutely necessary to work to radial and angular dimensions. To say that one method is correct and another incorrect shows poor judgment, for in drafting as, perhaps, in no other profession, each case must be settled on its own individual merits and it is the draftsman who recognizes this fact rather than the one who tries to follow fixed rules, who meets with the greatest success.

It would be interesting to know the experience of others in regard to the methods used in dimensioning drawings.

Roslindale, Mass. WILLIAM C. GLASS

THE MACHINIST VS. THE DRAFTSMAN

The machinist knows his biz,
Full of ginger and wisdom is,
To teach the draftsman, hand him one,
Correct his blunders, one by one
Is fondly dreamed in the shop,
In this reform one may not stop,
But gamely push on to the end
Or scribblers all to Hades send.
No let up, the machinist knows
In handing to the draftsman blows,
All figures wrong, all lines awry,
"Correct this lively, quick, step spry,
You nothing know of methods true
To do work right is not in you,
Go to it, man, and something learn."
Such the machinists' mandate stern.

But wait, another day rolls round.
"This job's a tough one, I'll be bound,"
To drawing-room he goes in sorrow,
That figure-fellow's wits to borrow,
"Come, lend your head, I'm in a fix,
That work went wrong, your figures, nix.
There's nothing mean about you folks,
The things we said were meant for jokes.
How can we figure out the angles?
These sine and tangent things are tangles,
Not meant for shop men, such as us,
They only get us in a muss,
Come, set us straight, we all are friends,
For wrong that's done we'll make amends.
We know full well your lines are true,
For figures we must look to you."

"Now look here, you machinist fellow,
Before again you boldly bellow,
Consider not the things you know,
Sum up all wisdom here below.
Your hasty thoughtless roar of brass
Is fully equalled by the ass.
Each to his part with equal care,
Your skill, our wit may well compare.
When lines confuse your woolly pate,
Our task is to elucidate.
Fault-finding let us leave to boys,
But newly weaned from childhood toys,
Our mutual efforts all must trend
To swell the boss's dividend."

Cincinnati, Ohio. GEORGE W. HART

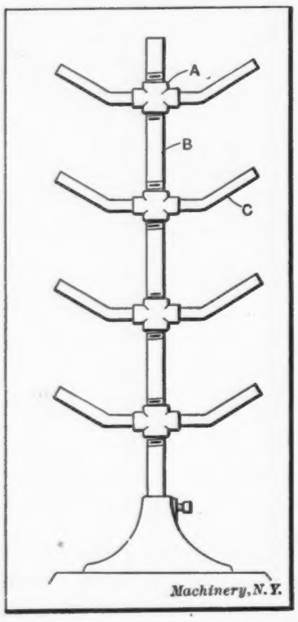
SHOP KINKS

PRACTICAL IDEAS FOR THE SHOP AND DRAFTING-ROOM

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

STOCK RACK

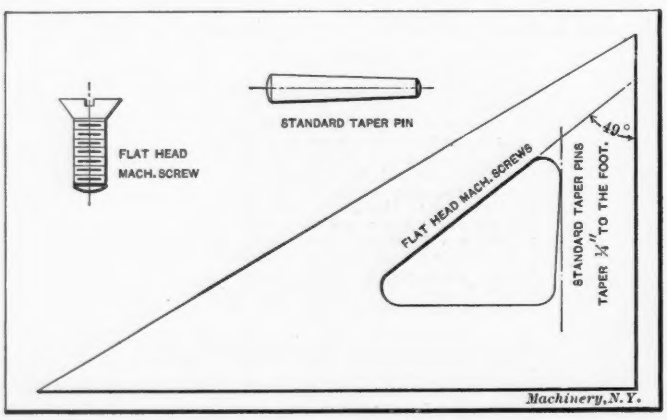
A rack that is designed for holding long rods of bar stock is shown in the accompanying sketch. This rack is particularly adapted to the screw machine department where, in many instances, stock is left on the floor for lack of sufficient room on the rack usually furnished with screw machines. Standards or racks of this construction can also be used in connection with the screw machine as supports, by adding a suitable supporting piece to the top. The number of arms or brackets can, of course, be made to suit requirements. The cost of this rack is comparatively small as all parts can be purchased ready to assemble. Part *A* is a ¾-inch by ½-inch malleable cross; *B* is a ¾-inch by 6½-inch nipple, and the arms *C* are also made of pieces of pipe, ½ inch in diameter by 8 inches in length. The nipples and pipe are extra heavy. The base may be obtained from the Brown & Sharpe Mfg. Co. These racks can also be used to good advantage in the stock-room for holding either rods or sheet metal.



Detroit, Mich. WILLIAM F. HOFFMANN

DRAWING TAPER PINS AND FLAT-HEAD SCREWS

Take a 60-degree celluloid triangle and cut away on the edge of the opening near the base or short side of the triangle an angle suitable for standard taper pins; and on the edge of the opening near the longest side of the triangle cut the



proper angle for flat-head machine screws. This will be found a handy templet in drawing taper pins and flat-head machine or wood screws, and not only saves the time necessary to get out a protractor, but cuts down the number of extra pieces lying around on the board. FRED. G. KENYON

Pawtucket, R. I.

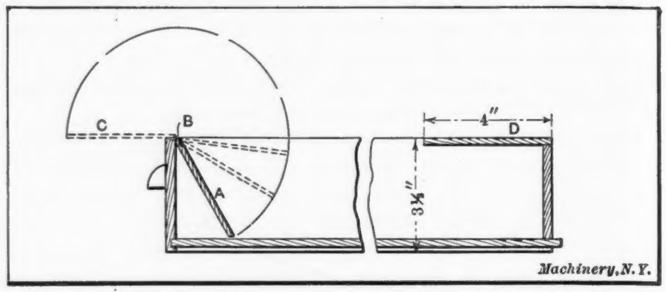
A KINK FOR THE DRAWING CABINET

The ordinary cabinet used for the filing of tracings and blueprints, is, at times, a source of annoyance and expense; the ends of the drawings have a tendency to curl up, with the result that in opening a drawer which provides for no protection to the contents, tracings and prints are sometimes caught and torn or creased—possibly ruined.

A cabinet equipped with the simple devices shown in the accompanying illustration will be found a decided improvement over the conditions found in many drafting-rooms. Interference with the contents in opening a drawer cannot occur, and the usual bar of scrap iron need not be in evidence.

At the front of the drawer a thin wooden strip *A* is hinged at *B*, and extends the entire width of the drawer. In cabinets holding drawings up to 42 inches wide, two 1¼ inch back flaps will be found most suitable. When the drawer is opened and in use, this strip is flung back as shown at *C*, leaving the contents unobstructed. The dotted positions of *A* show that the strip will keep the drawings flat and protected to the capacity of the drawer.

At the rear end of the drawer a fixed strip *D*, of suitable

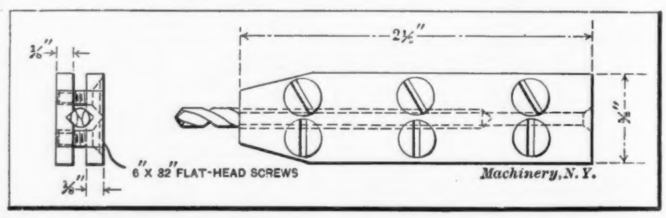


stock and about 4 inches wide, is fastened. This protects the contents at this point from working over the back. These additions can be applied to any size of drawer, and, while they can be more conveniently added while a cabinet is in the course of construction, they are also applicable to a constructed case. The slight expenditure involved is amply repaid by the usefulness and protection afforded to the drawings.

Los Angeles, Cal. L. R. W. ALLISON

CHEAP DRILL HOLDER

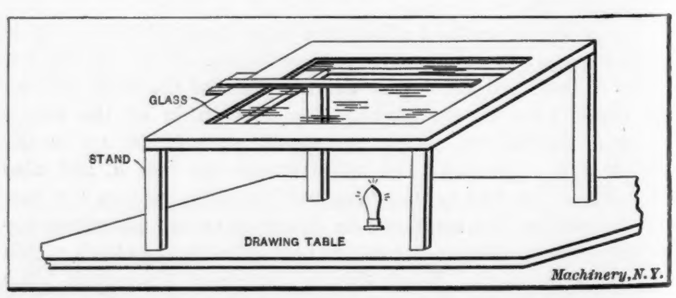
The accompanying illustration shows a cheap and simple drill holder for holding small drills when drilling in the lathe. As will be seen, this will hold a drill very securely if well



made, and very small drills can be held in this manner. If the grooves are cut 1/32 inch deep it will hold a drill from 1/16 inch to 3/16 inch in diameter. S. C.

TRACING THROUGH THICK PAPER

The writer was once called upon to make a number of show drawings. These were to be made on Whatmans hot pressed paper and were to be duplicates of tracings we had on hand. At first it seemed quite a task to draw these off in pencil and then ink them in, as considerable scaling would be necessary.



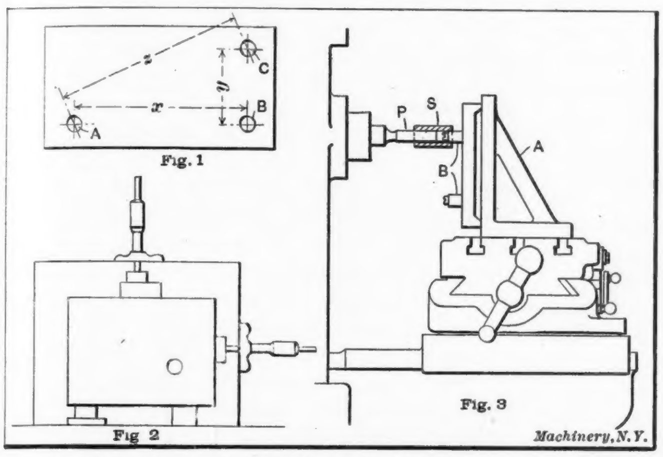
A shorter method than this was devised and is as follows: A piece of glass was set in a frame and used as a drawing-board. By putting this on a stand over an incandescent light as shown in the illustration, and putting the tracing paper under the heavy paper, it was found an easy matter to follow the outlines of the tracing. This was a very simple arrangement and saved considerable time. D. F. HUDDLE, JR.

Wilkinsburg, Pa.

MACHINE SHOP PRACTICE*

SETTING WORK FOR BORING ON THE MILLING MACHINE

It is often desirable to perform boring operations on the milling machine, particularly in connection with jig work. Large jigs, which because of their size or shape could not be conveniently handled in the lathe, and also a variety of smaller work, can often be bored to advantage on the milling machine. When such a machine is in good condition, the necessary adjustments of the work in both vertical and horizontal planes can be made with considerable accuracy by the direct use of the graduated feed-screw dials. It is good practice, however, when making adjustments in this way, to check the accuracy of the setting by measuring the center distances between the holes directly. For example, if holes were to be bored in a jig-plate, as shown in Fig. 1, hole *A* would be finished first; then after the platen had been moved a distance x as shown by the feed dial, hole *B* would be bored



Figs. 1, 2 and 3. Illustrating Methods of Setting Work to be bored

slightly under size. Plugs should then be accurately fitted to these holes, having projecting ends, preferably of the same size. By measuring from one of these plugs to the other with a vernier or micrometer caliper, the center distance between them can be accurately determined, allowance being made, of course, for the radii of each plug. If this distance is incorrect, the work can be adjusted before finishing *B* to size, by using the feed-screw dial. After hole *B* is finished, the knee can be dropped a distance y as shown by the vertical feed dial, and hole *C* bored slightly under size; then by the use of plugs, as before, the location of this hole can be tested by measuring center distances y and z. This method of testing with the plugs is intended to prevent errors which might occur because of wear in the feed-screws or nuts that would cause the dials to give an incorrect reading. On some jig work, sufficient accuracy could be obtained by using the feed-screw dials alone, that is, without testing with the plugs, in which case the accuracy would depend largely on the condition of the machine.

For the purpose of obtaining fine adjustments in connection with milling machine work, the Brown & Sharpe Mfg. Co., makes special scales and verniers that are intended to be attached to the machine so that the table may be set by direct measurement. By attaching a scale and vernier to the table and saddle, respectively, and a second scale to the column with a vernier on the knee, both longitudinal and vertical measurements can be made quickly and accurately.

The use of the button method as applied to the milling machine is illustrated in Fig. 3 where a plain jig-plate is shown set up for boring. The jig, with buttons *B* accurately located in positions corresponding to the holes to be bored, is clamped to the angle-plate *A* that is set at right angles to the spindle. Inserted in the spindle there is a plug *P*, the end of which is ground to the exact size of the indicating buttons, and closely fitted to this end there is a sliding sleeve *S*. When the work is to be set for boring a hole, it is adjusted until the sleeve *S* will pass over the button marking the location of the hole, which brings the button and spindle into alignment. After the button is set by this method, it is removed and the plug in the spindle is replaced by a drill and then by a boring tool or reamer for finishing the hole to size. In a similar manner the work is set for the remaining holes. The plug *P* for the spindle must be accurately made so that the outer end is concentric with the shank, and the latter should always be inserted in the spindle in the same relative position. With a reasonable degree of care, work can be set with considerable precision by this method, providing, of course, the buttons are properly set. Some toolmakers use, instead of the plug and sleeve referred to, a test indicator for setting the buttons. This indicator, which is similar to the kind used in a lathe, is attached to and revolves with the spindle, while the point is brought into contact with the button to be set. The difficulty of seeing the pointer as it turns, is a disadvantage, but with care accurate results can be obtained.

* With Shop Operation Sheet Supplement.

Another method which can at times be employed for accurately locating a jig-plate in different positions on an angle-plate, is shown in Fig. 2. The angle-plate is, of course, set at right angles to the spindle as before, but in this case, depth gages and size blocks are used for measuring directly the amount of adjustment. Both the angle-plate and work should have finished surfaces on two sides at right angles to each other, from which measurements can be taken. After the first hole has been bored, the plate is adjusted to the required distance both horizontally and vertically by using the standard size blocks in conjunction with the micrometer depth gages, which should preferably be clamped to the angle-plate.

A method that is a modification of the one previously referred to in which plugs were used to test the center distance is as follows: All the holes are first drilled with suitable allowance for boring, the location being obtained directly by the feed-screw dials. A special boring-tool, the end of which is ground true with the shank, is then inserted in the spindle and the first hole, as at *A* in Fig. 1, is finished, after which the platen is adjusted for hole *B* by using the dial as before. A close-fitting plug is then inserted in hole *A* and the accuracy of the setting is obtained by measuring the distance between this plug and the end of the boring-tool, which is a combination tool and test plug. In a similar manner, the tool is moved from one position to another, and, as all the holes have been previously drilled, all are bored without removing the tool from the spindle.

When a vernier height gage is available, it can often be used to advantage for this kind of work, and this method is one which requires little in the way of special equipment. The work is mounted on an angle-plate or directly on the platen, depending on its form, and at one end an angle-plate is set up with its face parallel to the spindle. An accurately finished plug is inserted in the spindle and this plug is set vertically from the platen and horizontally from the end angle-plate by measuring with the vernier gage. After the plug is set for each hole, it is, of course, removed and the hole drilled and bored or reamed.

By the use of a vertical attachment on a horizontal machine, jigs can often be conveniently bored by strapping them directly to the platen, thus doing away with angle-plates.

The proper method to employ for setting a given piece of work depends on the refinement required. In general, the best method would be one by which the necessary accuracy could be obtained with the least expenditure of time.

* * *

An ingenious scheme for overcoming the brittleness of the tungsten lamp filament when not burning has been devised by E. M. Fitz, the electrical engineer of the Pennsylvania Lines West of Pittsburg. This method consists in having a small current pass through the lamp when extinguished. On cars using 63 volts (32 cells), the two end cells of the battery, giving four volts, are connected to the lamps when extinguished. This keeps the filament at a faint dull red and makes it as strong as that of a carbon lamp. Recent tests show that the life of a tungsten lamp will vary from 1500 to 2000 hours when this system is used.

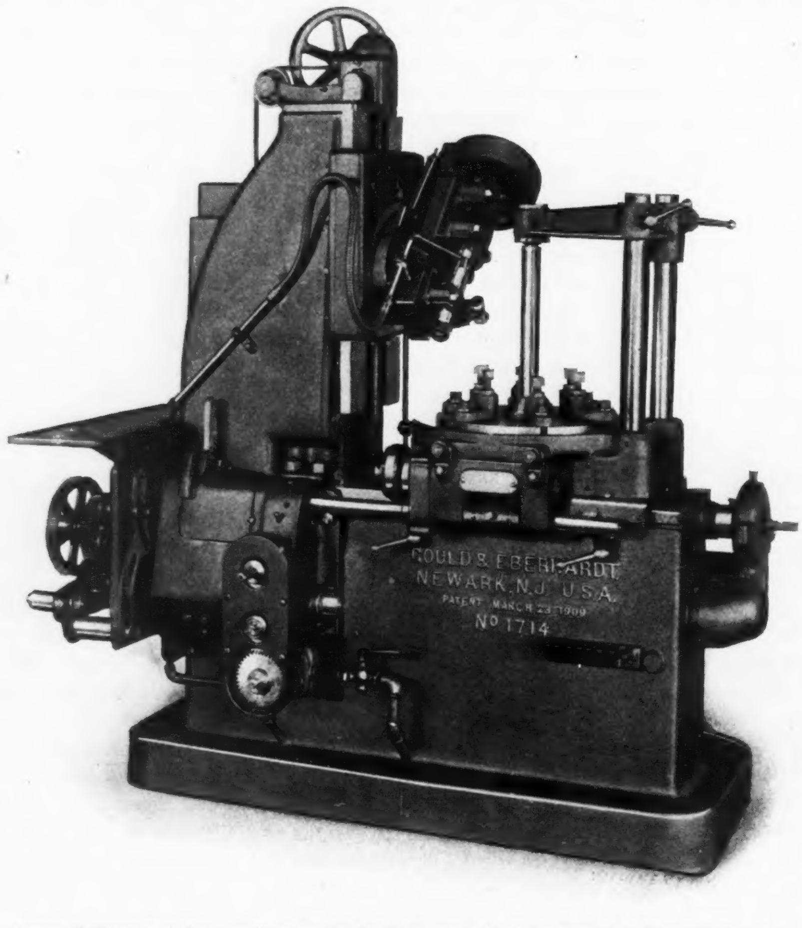
NEW MACHINERY AND TOOLS

A MONTHLY RECORD OF APPLIANCES FOR THE MACHINE SHOP

Comprising the description and illustration of new designs and improvements in American metal-working machinery and tools, published without expense to the manufacturer, and forming the most complete record of new tool developments for the previous month.

GOULD & EBERHARDT'S GEAR HOBBING MACHINE

One of the latest additions to the line of gear hobbing machinery manufactured by Gould & Eberhardt, Newark, N. J., is shown herewith. This machine is designed for cutting spur, helical and worm gears, and it has been the aim of the builders to so construct it that modern high-speed steel hobs could be driven to their maximum of efficiency; particular attention has also been given in the design to convenience of operation. The following description applies to two sizes of this machine, the 12- by 6-inch size with a capacity of 5 diametral pitch in cast iron and 6 diametral pitch in steel, and the 24- by 10-inch size with a capacity of 4 diametral pitch in cast iron and 5 diametral pitch in steel.



Gould & Eberhardt Automatic Gear Hobbing Machine for Spur, Spiral and Worm Gearing

The Work-table

The faceplate or revolving work-table of this machine is integral with the worm-wheel through which it is driven, thereby giving a rigid construction and reducing torsion to a minimum. The table is supported at its periphery by a bearing on the work-slide and it also revolves upon an anti-friction washer. The drive is so arranged that the table can be rotated in either direction to accommodate right- and left-hand spiral gears. The work-slide on which the table is mounted can be adjusted longitudinally on the bed or base, which adjustment is necessary when setting for different diameters or for the required tooth depth, and it is also used when cutting worm-wheels. The amount of adjustment is shown by a graduated dial reading to thousandths, and also by a scale and vernier which may be used to read the center distance between the work and cutter spindles. This vernier scale will also be found useful for obtaining the desired center distance when hobbing worm-wheels. The work-slide is adjusted by hand on a standard machine, but at a slight additional cost an automatic adjustment can be applied, with means for stopping the feed automatically when the teeth on the gear being cut have been hobbed to the correct depth. This arrangement is known as an automatic "in feed" and it is shown attached to the machine in the illustration. The indexing worm-wheel by which the table is driven, is of the split type and it is hobbed in place to insure accuracy. The driving worm is made of a high-grade of machinery steel and it is of coarse pitch, hardened and accurately ground. The worm runs in an oil bath and the bearings are so arranged that it can be conveniently disengaged from the worm-wheel so that the work-table may be revolved by hand to ascertain if the mandrel and gear blanks run true. This test is made by bringing an indicator, attached to the cutter-slide, into contact with the periphery of the blanks while they are being rotated. Means are also provided to always maintain a good running fit between the worm and wheel. By means of a micrometer adjusting device that is attached to the worm-shaft, the work can be adjusted circumferentially without disconnecting any mechanism. The work-table is surrounded by a guard cast integral with the slide, which forms a channel into which the lubricant and chips are deposited and from which they are carried to the front of the slide where they fall into the base of the machine.

Work Arbor Support

The work arbor is supported at its upper end by a rigid triangular arm which is mounted on two uprights. This support is a very important feature, particularly when long and slender mandrels are used; it is also essential to accuracy when helical gears with extreme angles are being cut, or when a number of blanks are mounted on the arbor at a time. A bearing sleeve of extra length, with which the support is provided on one side, makes it possible to swing it easily around for removing finished gears or placing new blanks on the work arbor. By removing the two uprights which carry the supporting arm, gears of a larger diameter than the machine is regularly rated for, may be cut.

Resetting Device

It is frequently desirable to take two cuts in helical gears, particularly when cutting the first gear of a given size to obtain the correct tooth thickness. To facilitate this work, a patented device is furnished with this machine which saves considerable time and eliminates experimental adjustments. When a helical gear is to be finished in two cuts, the resetting attachment is first set in a zero position. After taking the first cut, a re-cut may be taken through the same helices by merely returning the machine to the original or zero position to which it was set. Without such an arrangement it would be necessary either to cross the belt and run the machine backwards until the cutter slide had returned to its original position, loosen the gear on the mandrel, or take off the change gears in order to have the cutter cut uniformly on each side of the tooth.

The Cutter Slide and Spindle

The cutter slide, which may be swiveled to any angle, is mounted on a saddle that is vertically adjustable on the face

of the column. This saddle is counterbalanced, and it may be traversed either by hand or power, the handwheel being shown at the top of the column. The cutter spindle is powerfully geared and is so arranged that it always swings above the horizontal or across the top of the saddle when being changed for gears cut to the opposite hand. Means are provided so that when the cutter spindle is swung from one side to the other it will revolve in the proper direction. The cutter spindle has an axial adjustment for bringing the different hob teeth into action, and by means of a special gage that is located in the slide, the hob may be quickly and accurately set central with the blank, though it is not necessary to have the work in the machine at the time. This gage is located just back of the hob and it is moved out for testing by means of a small knurled thumb-nut.

Cutter Feeds and Speeds

The feeding mechanism of this machine is arranged in the base and it may be conveniently engaged and disengaged by means of a handle located at the side. The amount of feed is in accordance with the rotation of the work, regardless of the number of teeth or diameter of the blank. In other words, there is a definite amount of feed for each rotation of the blank. The feed change gears are located at the rear of the machine, as are also the change gears for obtaining the proper ratio between the hob and work. The required cutter speeds are obtained by means of a stepped driving cone. This cone runs on a patented sleeve bearing which takes all strains from the pull of the belt so that they do not come on the cone shaft itself. This arrangement makes an outer support for the cone shaft unnecessary and insures the proper meshing of the driving gears on this shaft. The proper speed for the cone may be selected from an index furnished with the machine. The countershaft is arranged so that there is a great variety of speeds obtainable at the cutter spindle.

Miscellaneous Features

A complete set of indexing gears is furnished to cut all numbers of teeth ranging from 10 to 100, and some numbers up to 400. The machine is so arranged that by special calculation, spiral gears having prime numbers of teeth may be cut without the use of special gears. An efficient oil pump is supplied with each machine to allow the use of a lubricant when cutting steel. This pump is attached to the side of the machine, as shown in the illustration, and it is driven by gears which may be easily disconnected when the pump is not in use. Any lubricant which drips from the machine is caught by an oil pan which extends around the base.

This type of gear cutter is adapted to the cutting of all classes of small and medium gears, such as change gears, gears for textile machinery, cream separators, automobile transmission and timing gears, herring-bone gears when made in halves, steering gears, lathe and drill-press feed worm-gears, etc. If desired, an electric motor drive can readily be attached and a variable speed motor with a ratio of 3 to 1, and a maximum speed not to exceed 1500 revolutions per minute, is recommended.

ADJUSTABLE BEARINGS FOR STURTEVANT BLOWERS

In the department of New Machinery and Tools for February, 1906, we described the high-pressure blower manufactured by the B. F. Sturtevant Co., Hyde Park, Mass. This company is now equipping large blowers of the type previously illustrated with the design of adjustable bearing shown in Figs. 1 and 2. This bearing is simple in its construction and greatly facilitates making the necessary adjustments.

The sleeve in which the shaft is mounted, is carried in a bed-block that is chambered out to form an oil reservoir. The four corners of this block are accurately beveled, as shown in Fig. 2, to fit the adjusting wedges. There are four of these wedges and each pair is connected by a right- and left-hand screw so that the turning of this screw in one direction, causes the wedges to separate, while a movement in the opposite direction draws them together, thus moving the bearings. If only one screw is turned, the bearing will move in a direction at 45 degrees with the horizontal, whereas by the manipulation of both screws, it can be adjusted in any direction. As most of the pressure, and consequently wear, is at an angle of about 45 degrees, ordinarily the required adjustment can be made by simply manipulating one screw. These screws are turned by applying a wrench to the squared ends which extend outside the housings. When the bearing is to be moved upward, care should be taken to loosen the nuts holding the bearing cap, before attempting to adjust the wedges.

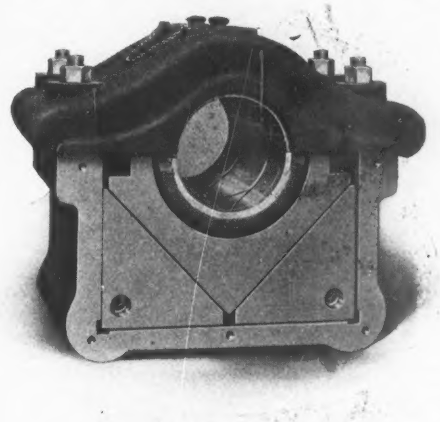


Fig. 1. Adjustable Wedge Block Bearing for High-pressure Blower

This type of bearing has proved very efficient in service, as the construction is solid, notwithstanding the adjustable feature. Medium-sized blowers built by this company are equipped with the type of bearing sleeve here illustrated, but the bearing, instead of being adjusted by wedges, is mounted in a bracket which is shifted to the required position by means of set-screws.

These bearings are lubricated by chain or ring oilers and they are provided with oil reservoirs which contain an ample supply. The bearings are of generous proportions, and they are lined with Sturtevant white metal, which is carefully hammered and accurately bored and scraped to a good running fit. On very small blowers the bearings consist of solid bronze sleeves which are lubricated by grease cups and which may easily be replaced when worn.

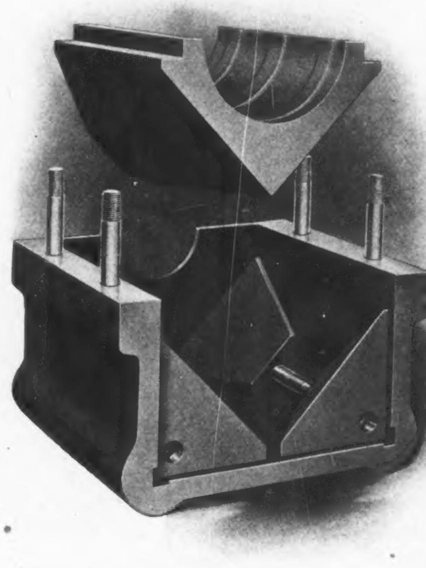


Fig. 2. View showing Construction of the Wedge Block Bearing

PRYIBIL BAND SAW MACHINE

A band saw machine that is an excellent example of modern machine design has been brought out by P. Pryibil, 512-524 West 41st St., New York City. This machine has not only been designed to work efficiently as a saw, but it is so constructed as to protect the operator, as far as possible, from injury.

As the accompanying illustrations show, the wheels are covered in front by hinged cast-iron doors which can be opened, as shown in Fig. 2, when this is necessary for inspection or for replacing saws. Any possibility of coming in

contact with the saw on the slack side, has been overcome by running the saw through a channel on the frame. This channel or guard also prevents the saw from being thrown off the wheels in case it should be accidentally struck in the rear. This machine is further safeguarded by a positive locking device which holds the belt shifter firmly in position after the belt has been shifted to the loose pulley. By this means the belt is prevented from accidentally running on the tight pulley and starting the machine while the saw is being adjusted. After stopping the machine, it is again started by releasing a spring pin which allows the belt to be shifted.

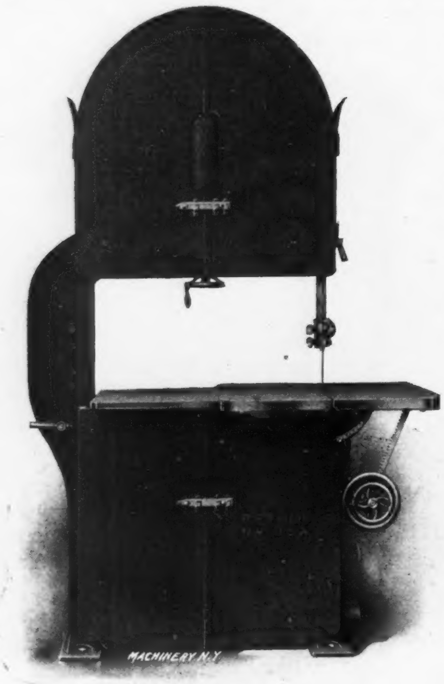


Fig. 1. Pryibil Band Saw Machine with Hinged Covers or Guards

As Figs. 2 and 3 indicate, the table of this saw can be tilted either to the right or left for taking angular cuts. The angular adjustment of the table is effected by a handwheel located just beneath it. This wheel is mounted on a sleeve carrying a pinion which engages a cut-steel rack that is hinged to the table. The second handwheel, mounted on a shaft that passes through the sleeve of the clamping wheel, serves to lock the table securely after adjustments have been made. The table can be tilted to the right to any angle not exceeding 45 degrees, and it has a maximum adjustment to the left

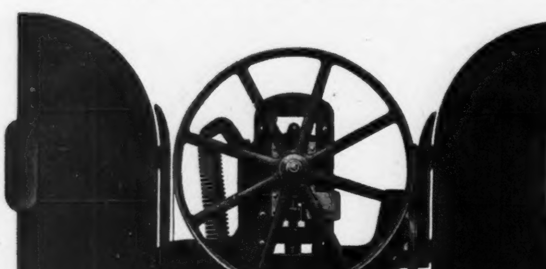


Fig. 2. View of the Saw with Guards Opened

of 5 degrees. A scale located on the semicircular segment on which the table swivels, indicates the exact angle. When the table is set at right angles to the saw, the left side is supported on a spacing block that is inserted between the under side of the table and the main frame. When the table is to be tilted to the left, as in Fig. 2, this spacing block is disengaged by a lever which is fulcrumed under the table. The throat disk through which the saw passes is located in a recess in the table so that it can easily be taken out for renewing the wooden lining with which it is provided.

The wheels of this machine are turned outside and inside and the inner faces of the rims between the arms are milled in order to obtain a running balance. The rims of both these wheels are threaded so that the rubber bands which are vulcanized to the rims will have a firmer grip. The lower wheel has been made extra heavy so that it acts as a flywheel. The reason for this construction is as follows: Whenever the saw encounters hard spots or knots, the speed of the lower or driving wheel tends to be momentarily reduced so that the saw will have to act as a brake for the upper wheel with the result that the tight side of the saw becomes the slack side, thus causing it to quiver and often to slip on the upper wheel under the reverse and additional strain. This action will, particularly if repeated, tend to break the blades. To overcome this defect, the lower wheel has been made heavier so that any additional load can be carried without an appreciable speed reduction. Within the housing for the lower wheel there is a dust collector which throws the sawdust to the front and directly into a suction opening which can be connected with an exhaust system. The upper wheel is comparatively light and it is mounted in a pivoted bearing, which, by means of a hand-screw, can be tilted so that the saw will run in its proper position. The shafts on which these wheels are mounted are of large diameter, and both bearings are lined with genuine babbitt metal and reamed to a perfect fit. They are self-oiling, there being large reservoirs and soft felt wicks for supplying lubricant.

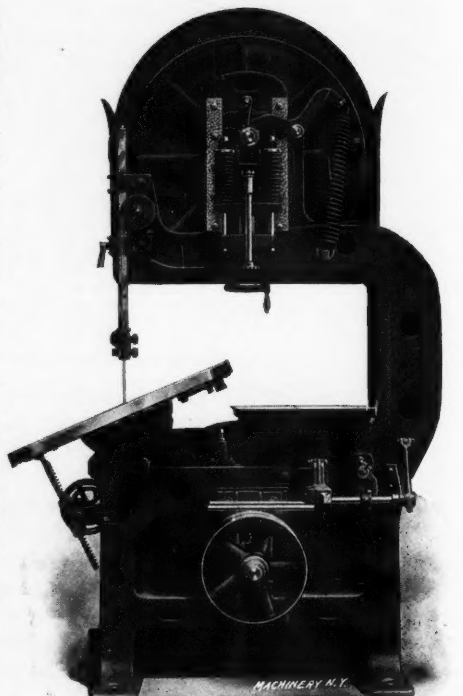


Fig. 3. Rear View of Band Saw

The saw guides are of the Pryibil anti-friction type, there being one fitted to the guide-bar and another to a seat in the frame beneath the table. The guide-post is a finished square steel bar and it is counterbalanced by a coiled steel spring set in an iron casing. This guide-post can be clamped in position at any required height.

If a saw is to operate satisfactorily, it must run steadily and without quivering at a high velocity, and to obtain these results it is essential that the tension be correct and remain absolutely uniform under varying conditions. The mechanism for tensioning this saw is very sensitive and the correct tension for all sizes of blades is indicated by a graduated dial. The tensioning mechanism is mounted on a slide that is fitted into plain guides on the upper part of the frame. This slide, which is shown in the rear view of the machine, Fig. 3, is adjustable for saws of different lengths as well as for tensioning, the adjustment being obtained by operating the handwheel shown. This wheel is easily turned, as the weight of the slide with its mechanism is balanced by a large spring. The bearing for the upper wheel shaft is pivoted near its front end on a pin held in a secondary slide that is fitted in guides on the main slide. This secondary slide is connected by suitable levers to a piston which operates in a cylinder that is

suspended from the main slide by two guide shafts as shown. The piston has arms that extend on each side and embrace the guide shafts, and between these arms and the brackets on the main slide, springs are interposed which are compressed to give the saw the required tension. Inside the springs shown, a second set is located, which only comes into action after the outer springs have been partly compressed. The outer springs alone give sufficient tension for blades up to ¾ inch in width, while those ranging from ¾ to 2 inches in width are held in tension by both springs. When a saw is to be placed under tension, the compound slide is moved upward by the handwheel previously referred to. As this upward movement takes place, the secondary slide (located in the main slide) remains inactive until the wheel comes into contact with the saw. The secondary slide is then held in position by the saw, while the other slide continues to rise against the tension of the springs. This vertical adjustment is continued until the dial indicates the proper amount of tension. If the saw should break for any reason, the springs, being under compression, would immediately expand and cause the secondary slide and wheel to be forced upward with a jar, were it not for the air piston and cylinder which acts as a dash pot and allows the springs to expand to their original position without the slightest jar.

The main table of this machine has a width of 34 inches and a length of 40 inches, while the auxiliary table has a width of 20 inches and a length of 27 inches. Saws having a maximum length of 20 feet, 3 inches and a minimum length of 18 feet, 6 inches can be used. There is a maximum sawing space of 18½ inches under the guide, and from 3 to 5 horsepower is required for operating the machine.

WILMARTH & MORMAN LATHE CENTER GRINDER

The importance of keeping lathe centers ground true is generally appreciated, but centers are often neglected because of the time that is required to re-grind them with some of the

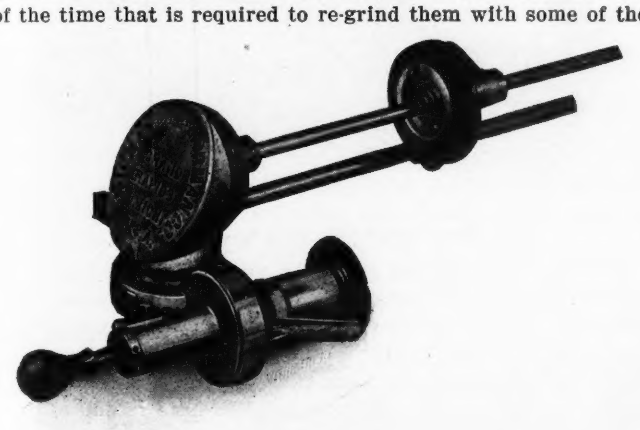


Fig. 1. Wilmarth & Morman Lathe Center Grinder

appliances that are used for this purpose. The Wilmarth & Morman Co., 580 Canal St., Grand Rapids, Mich., is now manufacturing a grinder for truing lathe centers which is simple in construction and easily attached to a machine; in fact, it may be applied so quickly that centers can be trued with practically no loss of time.

In Fig. 1 this grinder is shown complete, while Figs. 2 and 3 indicate the method of setting it in the lathe and its position when in use. The grinder consists of a casing *C* which is mounted on a base *B* that is attached to the toolpost by a shank or holder. The casing *C* is free to swivel on the stationary base so that the driving shaft *S*, on which is mounted a rubber friction disk *D*, can be swung in a horizontal plane. This driving shaft is held rigid by an auxiliary supporting shaft to which it is connected by a casting which also provides a bearing for the friction driving disk. The drive is taken directly from the lathe cone by swinging the grinder around until disk *D* is in contact with it. The power from the driving shaft *S* is transmitted through a bevel gear and pinion, located in casing *C*, to a pair of spiral gears in the base which, in turn, drives the grinding spindle and wheel *W*.

It is this bevel gear and pinion drive in casing *C* which makes it possible to swivel the upper gear housing to any angle, as this angular movement merely rotates the bevel gear on shaft *S*, around its pinion.

When the grinder is to be set up in the machine, the locating lugs *L* on the main base casting are placed between the head- and tail-stock centers. These jugs are provided with hardened tool steel centers which are set at an angle of 30 degrees with the center line of the wheel spindle, so that the latter is located at the correct angle for grinding. While the grinder is accurately located in this way, the toolpost holder

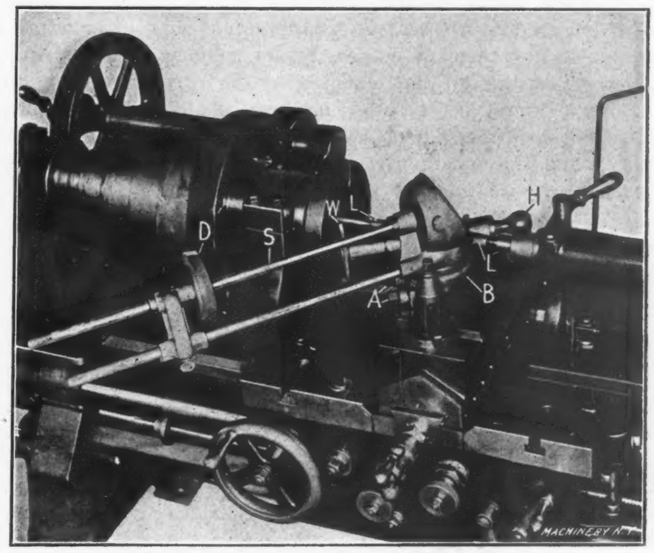


Fig. 2. Method of Setting the Lathe Center Grinder

is clamped in place. Before tightening this holder, however, the two set-screws *A* which hold it to the base are loosened to prevent the grinder from being thrown out of the position in which it has been located by the centers, which might be the result if a rigid connection were employed. After the shank is clamped, screws *A* are tightened, thus fixing the grinder in the correct position.

In Fig. 3, the attachment is shown in position for grinding, the tailstock center having been withdrawn and the grinding wheel moved up to the headstock center by manipulation of the lathe carriage and cross-slide. The wheel is traversed to and fro across the center by means of the handle *H* (Fig. 2) which is attached to the end of the sliding wheel spindle. Fig. 3 also shows the friction driving disk moved

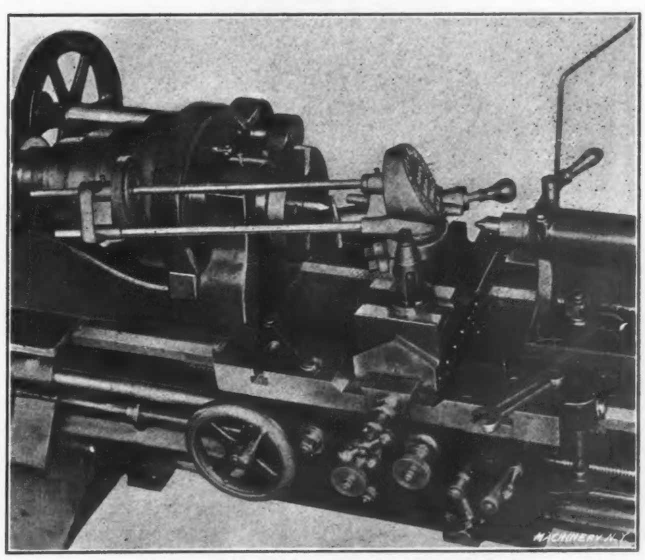


Fig. 3. Center Grinder in Working Position

around in contact with the lathe cone against which it is held by means of a handle, formed on the casting connecting the driving and supporting shafts.

By means of carefully lubricated bronze bearings and the use of ball thrust bearings where needed, the friction of this grinder has been eliminated as far as possible. Aluminum

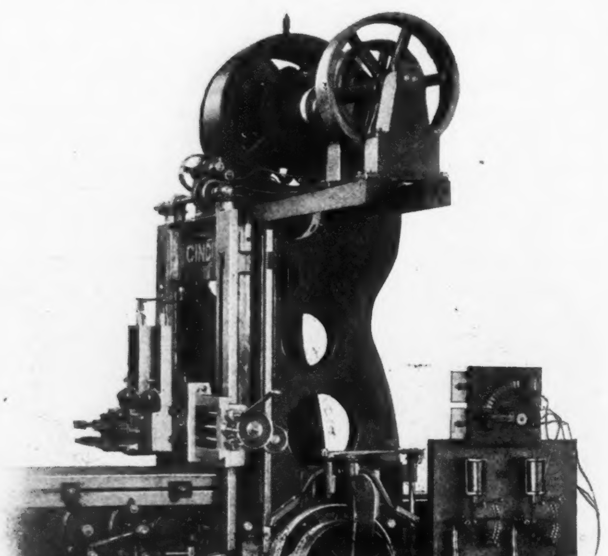
is used for the main casting and for other parts where practicable, so as to make the grinder light and easy to handle. By means of a telescoping sleeve at the rear of the wheel, the bearing is protected from grit and dust. The toolpost holder is of ample size and is made of cast steel to give the required rigidity.

Some idea of the time required for truing a center with this device, may be had from the fact that but 1 minute and 5 seconds, was required for transferring the grinder from the floor to the lathe, making all necessary adjustments, grinding the center, and removing the attachment from the machine. In this particular instance, however, only a moderate amount of grinding was necessary. As the actual time of grinding a center is governed, of course, by its condition, the time for actually setting up the machine to the correct position for grinding would be a better measure of its efficiency. The time required for placing this grinder in the machine, locating it, starting and then stopping the lathe, and removing the grinder, is said to be less than one minute.

CINCINNATI VARIABLE-SPEED PLANER DRIVE

An interesting type of electric speed controller has recently been applied to a 36-inch forge planer built by the Cincinnati Planer Co., Cincinnati, O. This controller, which is shown attached to the planer in the accompanying illustration, is so arranged that either the cutting or return speeds can be varied independently, thus enabling the operator to change the speed of either the cut or return stroke to suit conditions.

The motor by which the planer is driven, is mounted on top of the housings in a manner similar to the regular plain motor drive. As the illustration shows, the motor is coupled direct to the countershaft, thus doing away with all gearing. A 2 to 1 variable-speed type of motor is used, and its speed is governed by the two electric controllers shown mounted on the switchboard that is located at the rear of the housings. By means of one of these controllers, any desired cutting



Cincinnati Planer equipped with Electric Variable-speed Controlling Mechanism

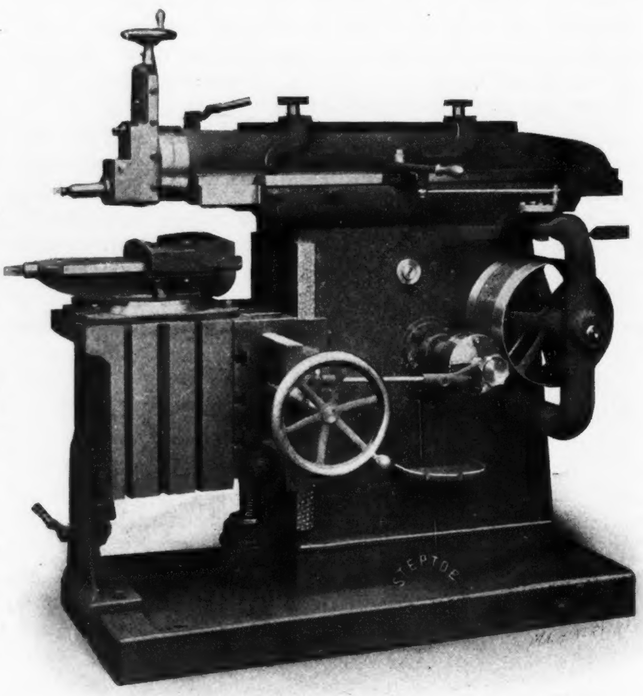
speed ranging between 25 and 50 feet per minute can be obtained for the cutting stroke, without in any way altering the return. The other controller is for the return speed and it enables variations ranging between 50 and 100 feet per minute to be made without affecting the speed of the cut. It is evident then that with this new speed controller, it is possible to operate with a cutting speed of say 40 feet and a return speed of 60 feet, or a cutting speed of 20 feet with a return speed of 90 feet, etc., the different speeds being varied to suit the requirements.

Just in front of the housing, a limit switch is located which operates the controlling levers so that after they have been set for any particular speed, they will automatically return to that speed at each stroke. It will be noted that a standard type of starting box, which is shown mounted on top of the switchboard, forms a part of the equipment. The wiring, illustrated in the engraving, is only temporary. This method of control does not need any more wiring than a regular drive except that wires have to run to the limit switch.

STEPTOE 26-INCH TRIPLE-GEARED SHAPER

The accompanying halftone shows a new 26-inch triple-geared shaper that has recently been brought out by the John Steptoe Shaper Co., 2951 Colerain Ave., Cincinnati, O.

The ram of this machine is driven by two gears of large diameter which mesh with racks that are cut from a solid



Steptoe 26-inch Triple-geared Shaper

steel bar. The teeth in the racks are staggered which eliminates excessive jarring at the ends of the stroke and gives the ram an even, steady movement. The use of two driving gears permits the passing of long bars through an opening in the top of the column, when this is necessary for keyseating or in connection with other work. The head of the ram can be quickly loosened, swiveled and clamped to any angle by means of the clamping lever shown just back of it. The shifter dogs are placed on top of the ram, thereby permitting the latter to be of larger dimensions and greater strength.

The cam plate for shifting the belts, has eccentric slots so arranged that one belt is shifted before the other, thereby avoiding the unpleasant screeching of the belt which is frequently heard in triple-geared shapers. The outer support is, as the engraving shows, of very strong construction.

All the shaft bearings in the column of this machine are bushed with cast-iron bushings and they are provided with ring oilers. The shafts also have spiral oil grooves to insure the proper distribution of the lubricant over the entire bearing.

The vise has a swivel base which is graduated so that it may be set to the required angle. The upper jaw of this vise grips firmly around the lower jaw, so that it is prevented from rising when work is being tightened in the vise. Two additional clamping bolts are provided which extend through the upper jaw so that the latter can be fastened when considerable accuracy is necessary, the bolts overcoming any tendency on the part of the jaw to rise when the work is clamped.

The apron, as well as the table of this machine, is slotted, thereby providing liberal clamping surface. The table support

has a roller, as shown, which bears against a plain surface under the table. This roller can be quickly adjusted by means of the clamping lever shown. All the wearing surfaces are provided with flat gibs and the screws for adjusting the gib in the ram and "harp slide" are equipped with lock-nuts. The feed-screw and the harp-slide screw are provided with handwheels which will be found very convenient. This machine is geared in the ratio of about 42 to 1 and it is designed to take heavy cuts in high-speed steel. The column, ram and base are heavily ribbed and braced, and all the bearings are liberally proportioned.

LODGE & SHIPLEY SPECIAL DRILLING LATHE

The Lodge & Shipley Machine Tool Co., Cincinnati, O., has recently completed an interesting special drilling attachment which is shown in Figs. 1 and 2 applied to one of the 30-inch by 30-foot motor-driven patent-head lathes built by this company. This attachment is intended for drilling 4-inch holes longitudinally through the centers of steel locomotive driving wheel axles, the purpose of the holes being to permit inspecting the interior of the forging for defects, such as seams due to piping, etc.

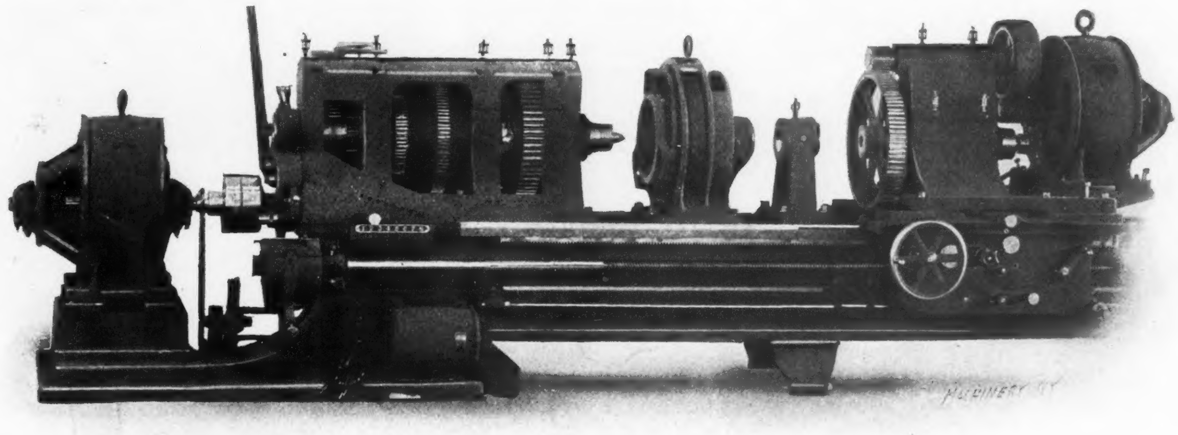


Fig. 1. Lodge & Shipley Lathe with Special Attachment for Drilling Locomotive Axles

A front view of the lathe is shown in Fig. 1 in which some of the gear covers are removed to better show the gearing of the headstock and of the special drilling attachment. In the rear view of the lathe, these covers are shown in place, all gears ordinarily being completely covered so as to fully safeguard the workman. This special drilling attachment is mounted on the carriage as shown. It consists of a heavy bracket to which is attached a 4¾-horsepower variable-speed motor, that is connected to the main driving shaft through gearing and an intermediate shaft. The drill itself is carried in the main driving shaft which is in exact alignment with the lathe spindle.

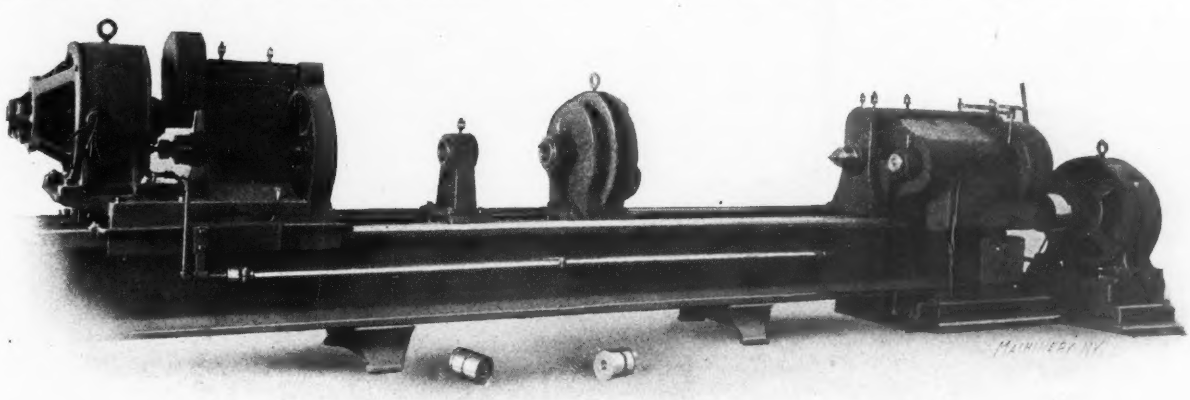


Fig. 2. Rear View of the Special Drilling Lathe

One end of the axle to be drilled is gripped in a chuck (not shown) on the lathe spindle, while the other end is supported by a special steady-rest that is shown between the headstock and carriage in the illustration. That portion of the steady-rest which carries the end of the axle has a large annular bearing which revolves with the axle. The other side of the steady-rest serves as a guide for the drill which passes through a bushing that revolves with it. The particular bushing shown in place is for a 4-inch drill while those on the floor are for a 2-inch size. Between the steady-rest and carriage there is an intermediate drill rest and guide which is also equipped with a revolving bushing that supports the center of the drill. These bushings, while free to revolve, are kept from endwise movement by set-screws, the tips of which enter annular grooves cut around the center. When the hole is being drilled, the work revolves in one direction and the drill, of course, in the opposite direction. The rotation of the work, which is slow as compared with that of the drill, serves to keep the hole concentric.

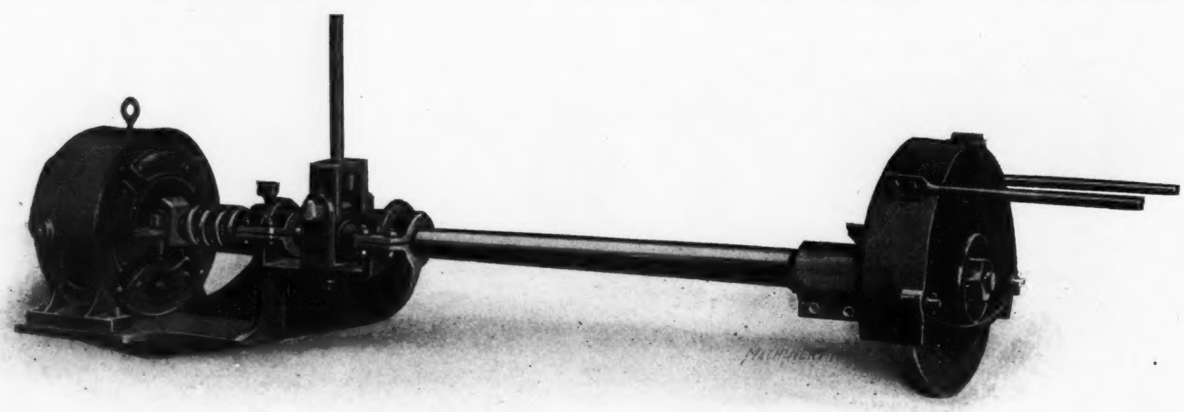
To take care of the unusual end-thrust required to drive a 4-inch drill, the headstock of this lathe is provided with a special tie-piece across the top, that is fastened to the caps of each one of the four bearings. The front and rear gear covers of the headstock are bolted to each side of this tie-piece. The headstock gearing gives six mechanical changes of speed, which are supplemented by a 2 to 1 speed variation in the 10 horsepower main driving motor.

The arrangement of pump and piping is shown in Fig. 2. The pump is placed near the end of the headstock, and it is positively driven by a chain from the motor shaft. This forces the lubricant through the piping at the back of the bed, and up to the center of the main driving shaft of the drilling attachment. The lubricant then passes through the drill itself and is discharged at its tip. The pipe joint just below the carriage is fitted with a stuffing-box, so that the rear section of pipe telescopes the adjoining section. This makes a good joint and insures proper lubrication of the drill, regardless of the location of the carriage. The whole machine stands in a pan (not shown in the illustration) to retain the lubricant and chips.

HASSEL MOTOR-DRIVEN GRINDER

A motor-driven grinder which has proved very efficient for removing surplus metal from castings and for smoothing rough surfaces, has been placed on the market by the Pittsburg Steel Foundry Co., Pittsburg, Pa. This grinder, which is shown in the accompanying halftone, is rigid from end to end and it is balanced on a pivot from which it is suspended. The wheel is driven by a Westinghouse 5-horsepower direct-current motor, which rests on a bracket or frame of which the suspending pivot casting is a part. The entire grinder is so counterbalanced that the wheel tends to rise when released by the operator. Chain suspension is ordinarily used, which enables the grinding wheel to be swung horizontally through a wide arc. The motor shaft is connected to the wheel shaft by a rigid coupling. The wheel shaft is mounted in two bearings provided with grease-cup lubrication, and it is encased throughout its entire length by a heavy tube which supports the grinding wheel. It should be mentioned that grease has been found superior to any other lubricant for this grinder, because it works through the bearings enough to form ridges at the ends which practically seal the bearings against the entrance of dust.

The workman, in the operation of this grinder, grasps the two rods or handles which are shown bolted to the wheel casing, and moves the wheel across the part to be ground. As the working position is beside the wheel, sparks do not interfere with the movement of the operator or his observation of the work. The emery wheel of this grinder is 24 inches in diameter, it has a 4-inch face and is encased in a heavy cast-steel safety shield. In the foundries of the manufacturer of this tool, it has been subjected to severe service, the operation being continuous day and night and often with the full weight of two men on the handles. An emery wheel of the size previously mentioned, is worn out in about 48 hours on the average and this time has been as low as 24 hours. No trouble has ever been experienced with the motor, however, under these severe tests, either in heating or commutation, and the shaft bearings have required very little attention. The advantages claimed for this tool are: the absence of belts, freedom of vertical and horizontal movements, safety, and durability. When compared with belt-driven grinders, for which this type was substituted, the saving in belts alone is said to be sufficient to pay for the beltless grinder in about two years.

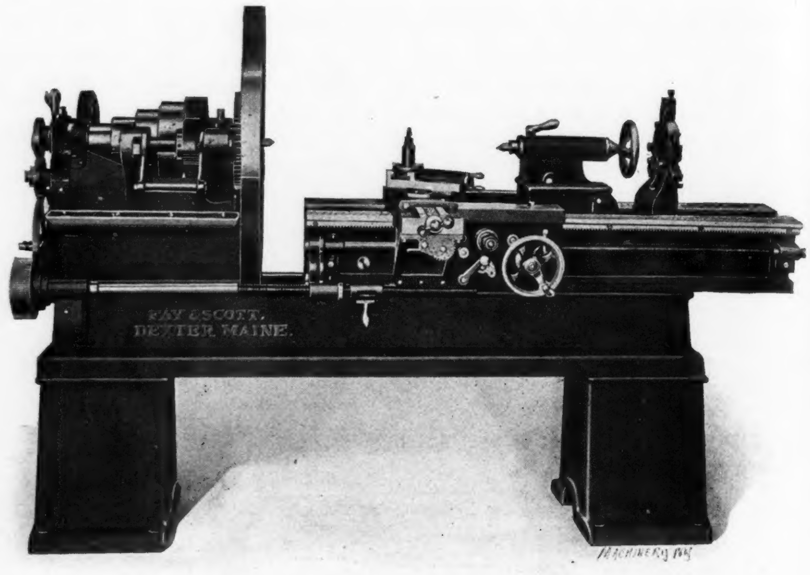


Hassel Motor-driven Grinder for Foundries, etc.

FAY & SCOTT EXTENSION GAP LATHE

The extension gap lathe shown in the engraving, is a new size recently added to the line of this type of lathes manufactured by Fay & Scott, Dexter, Me. In the construction of this machine, several important features not found in former designs have been incorporated, though the general construction is practically the same. One of these improvements is in the application of power for moving the upper bed, this adjustment having been made formerly by a hand feed screw. The power is applied by means of a small handle that may be seen projecting downward about midway of the lathe. This handle is attached to a half-nut that is lifted into mesh with the thread on the feed-rod, thus transmitting a power movement to the upper bed.

The bed is deep and rigidly designed, and the inside front track is flat to provide a bearing for the waist of the carriage. The upper and lower beds are carefully scraped and fitted together and they can be fastened rigidly by means of clamps. When the upper bed is extended for long lengths, jack-screws are furnished for supporting it. The rear end is cut away to allow the overhang or removal of the tailstock. The latter is of the improved cut-away type and it is adjustable for taper work. The clamping device for the tailstock spindle consists of a split bushing which eliminates danger of throwing the spindle out of alignment. The headstock has renewable spindle bearings of bronze and a hollow, hammered-steel spindle with ground bearings. All the headstock gears are covered with guards and the back gear lever has a positive locking device. The carriage is extended in the front for use in connection with the full swing of the lathe with the gap in use. This extension is rigidly supported by an angle bracket, as shown, which has a bearing against the apron, which, in turn, is supported against the upper bed by an adjustable gib. The apron has the double-plate construction and it is of the bevel gear driven type. The feeds are positively locked out when cutting threads.



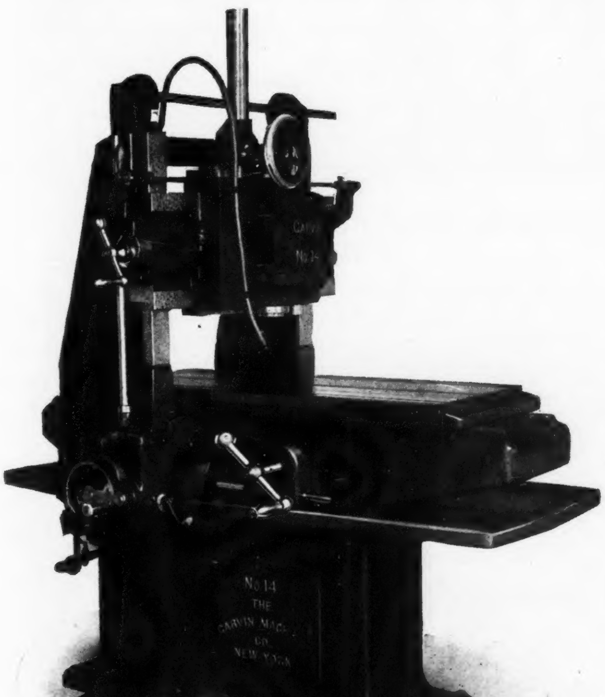
Fay & Scott 14 and 28 inch Extension Gap Lathe

This lathe swings over the shears, 14¼ inches; over the carriage, 8¼ inches, and in the gap, 29 inches. The 8-foot machine takes 63 inches between the centers with the bed closed, and 94 inches with it extended. The gap has a maximum opening of 32 inches. The thread-cutting capacity

ranges from 4 to 64 threads per inch. The equipment consists of a double friction countershaft, a plain or compound rest, a center rest, a full swing faceplate, a driving faceplate, wrenches, and a complete set of change gears. This lathe is particularly adapted for garage and general repair work.

GARVIN VERTICAL SPINDLE MILLING MACHINE

The No. 14 vertical spindle milling machine built by the Garvin Machine Co., Spring and Varick Sts., New York City, has recently been re-designed and important improvements have been made to increase the general efficiency of the machine. By reference to the accompanying halftone engraving, it will be seen that the standard rotary feed box used in this company's horizontal milling machines, has been adapted to the requirements of the vertical spindle machine. This feed box has twelve changes, ranging in geometrical progression, with the addition of a reverse movement for changing the direction of the feed. The feeding movement is transmitted to the head on the rail or to the work-table. Should the feed for one need to be different than the other, the desired feed can be quickly obtained by simply turning the crank shown attached to the side of the box. An illustrated description of this rotary type of feed box appeared in the department of New Machinery and Tools for March, 1910, in connection with an article descriptive of the Garvin geared feed milling machine. The feeds for the table and cross-slide are automatic in both directions. These feeds have an automatic trip which is so designed that the feed is thrown out a little before the



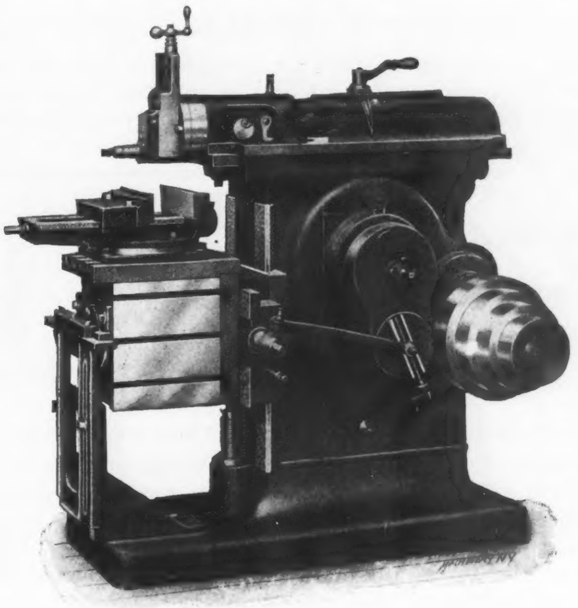
Vertical Spindle Milling Machine with Rotary Feed Box

positive stop is reached, so that the breaking down of the feed works by carelessness in setting the trips, is prevented. The speed changes for the spindle of this machine are through back-gearing which is located in the head as in previous designs. The different speeds are obtained by the operation of a single lever which through a rack and pinion movement shifts the gears that connect the driving shaft with the spindle. There are three positions for this lever, two of which give different back-gearing ratios, while the third is a neutral position. When the lever is in the neutral position, the universal joint drive can be disengaged from the back-gear shaft and attached directly to the spindle, thus giving a high-speed direct drive without gearing. The vertical slide of the head has a spring balance which is enclosed in a tube that may be seen extending above the slide. The depth of cut can be regulated by a micrometer gage stop which can be locked in position by a binder nut when necessary.

STOCKBRIDGE 16-INCH BACK-GEARED CRANK SHAPER

The Stockbridge Machine Co., Worcester, Mass., is now building the 16 inch back-geared shaper shown in the accompanying halftone. This machine, while adapted for tool-room work, is also sufficiently heavy and rigid to meet the requirements of a manufacturing tool.

Among the new features incorporated in the construction may be mentioned the method of attaching the cross-rail to the column. The gib on one side of the column ways is cast solid with the cross-rail, there being one adjustable gib located on the working side of the shaper. With this construction, which is similar to that employed on milling machines, adjustments may be quickly made and the cross-rail locked to the column by simply tightening the gib binder screws on the working side of the machine.



Stockbridge 16-inch Back-geared Crank Shaper

The rocker arm used in this shaper is of a special design that has exceptional strength. The slot in the rocker arm has an unusual depth and width to provide ample surface for the crank-block.

The ram has a semi-circular shape on the top with straight sides, which construction, in addition to the internal ribbing, gives the ram ample strength and stiffness. For taking up wear in the ram ways, tapered packings are provided which extend the entire length of the column and are adjusted from either end by means of screws. The head can be adjusted to any angle, and it is accurately graduated; it is locked in place by two bolts, one on each side. Either a hand or automatic down-feed can be provided for the head, and the slide has a graduated collar reading to thousandths of an inch, which can always be set to the zero position. The cross-feed is automatic in either direction and adjustments can be made while the machine is in motion.

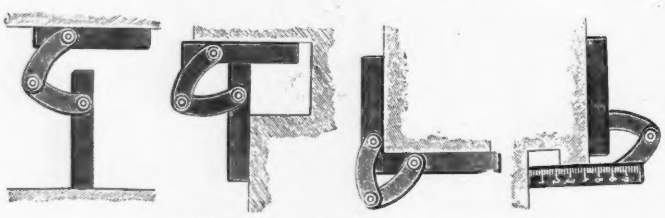
As the engraving shows, the base of this machine has an extension in front to which work may be clamped when necessary, there being slots provided for that purpose. The table is rigidly supported at its outer end by an angle-iron that is bolted to the base and has a sliding upright which adjusts itself to various heights of the knee automatically. By tightening two bolts, the slide and angle-plate are securely locked together. In addition to this support, the knee is hooked over the saddle so that the latter takes the forward thrust which would otherwise come on the bolts that hold the knee to the saddle. Vertical adjustments of the knee are obtained by means of a telescopic screw which has a ball thrust bearing.

The driving cone is supported by a self-oiling bearing that is built out from the side of the column. This bearing takes all the belt pull and thus relieves the driving shaft. The 4-step cone, in conjunction with the back-gears, gives eight changes of ram speed. All change gears are made of steel, and the driving shafts are carried through the column and are supported at both ends by self-oiling bushed boxes.

This shaper has a maximum stroke of 16¾ inches; a vertical travel for the table of 14¾ inches; and a horizontal travel of 23 inches. The head has a feed of 6½ inches. The minimum and maximum distances from the ram to the table are 2½ inches and 17 inches, respectively. The ram has a bearing in the column of 30 inches; a length of 36 inches, and a width in the column of 10¼ inches. The weight of the machine, complete, is 2850 pounds.

E. G. SMITH CO.'S UNIVERSAL ANGLE GAGE

The accompanying engraving illustrates a universal angle gage which has been brought out by the E. G. Smith Co., Columbia, Pa. This gage is simple in construction and will last indefinitely as there are no parts to become deranged. It consists of two straightedges that are connected by the curved



Views showing Various Applications of Universal Angle Gage

pieces shown. As the three adjustable connecting joints permit the straightedges to be placed at any angle with each other, this gage can be employed for a variety of purposes, some of which are indicated by the illustrations. For example, it may be used as a protractor, height gage, square and in a variety of other ways.

WALTHAM FILING MACHINE

The Waltham Machine Works, Waltham, Mass., has placed on the market a filing machine that is particularly adapted to die work and especially for the making of small sub-press dies for watches, clocks and similar work.

The work-table of this machine is 5 inches in diameter, and it can be tilted for filing the clearance angle and swiveled in a horizontal plane for a complete revolution while in the tilted

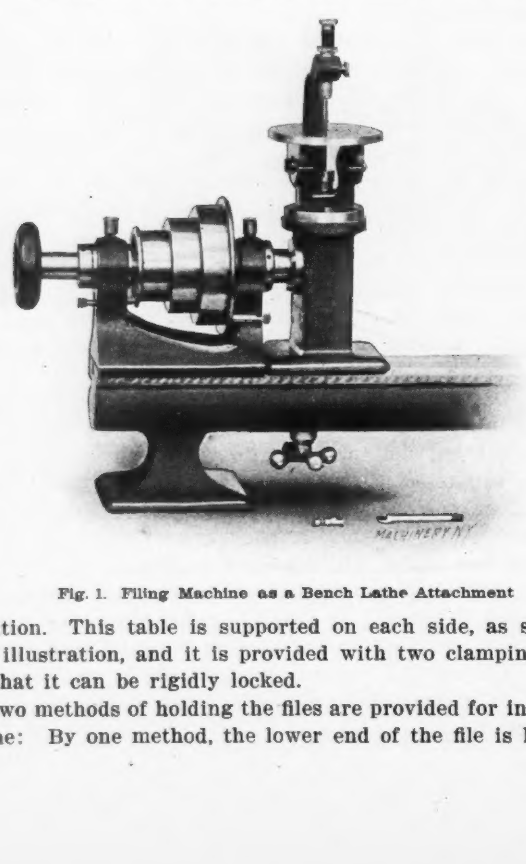


Fig. 1. Filing Machine as a Bench Lathe Attachment

position. This table is supported on each side, as shown in the illustration, and it is provided with two clamping screws so that it can be rigidly locked.

Two methods of holding the files are provided for in this machine: By one method, the lower end of the file is held in a vise while the upper end is gripped by a split chuck. As the vise has a vertical V-groove and the chuck four wide slots, either round or flat shanks can be securely held. With the second method, cross holes are drilled in the ends of the files which are looped over pins in the frame, similar to the manner in which a hack-saw blade is held in place. This method is desirable when very thin files or diamond-charged strips are being used, for by means of the nut at the top of the frame, considerable tension can be obtained. The upper spindle can be detached from the frame with the file, thus making it easy to remove a file from a die by simply releasing the lower end. Files having lengths ranging between 2 inches and 3½ inches can be held, and a set of assorted files is furnished with the machine. The stroke of the frame can be adjusted to any length up to 1½ inch.

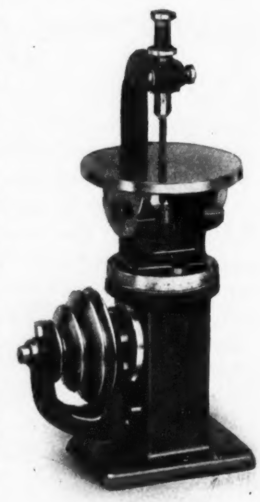


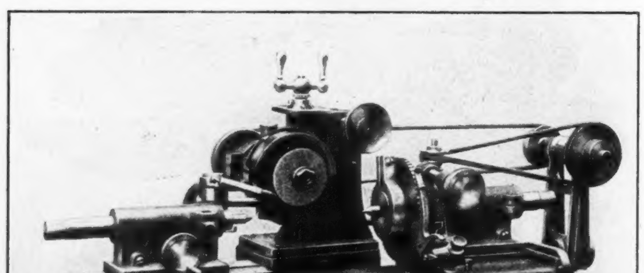
Fig. 2. Waltham Filing Machine with Independent Drive

This machine can be furnished either as an attachment to a bench lathe or as an independent machine. The first type when in use, is mounted on the bench lathe bed as shown in Fig. 1, and driven by a special chuck in the headstock spindle. A machine with an independent drive is shown in Fig. 2, the drive being in this case by means of a three-step cone pulley which is supported by an outboard bearing.

The height from the base to the table is 9¾ inches and the weight of the machine, 21 pounds. The workmanship is of the same grade as that employed on the watch machinery manufactured by this company.

MEISSELBACH-CATUCCI HOB GRINDING MACHINE

The Meisselbach-Catucci Mfg. Co., of 29 Congress St., Newark, N. J., is now manufacturing the hob grinding machine shown herewith. This machine grinds the teeth radially and



Meisselbach-Catucci Hob Grinding Machine

during the grinding operation there is an abundant water supply to prevent burning the edges of the cutter, both of which are important considerations. Means are provided for quickly setting the face of the emery wheel radial with the work, and the wheel face is kept true by means of a diamond tool that is held in a simple fixture. The teeth of the cutter are not depended upon for the spacing required in grinding them, as work is independently re-divided by a large and accurate index plate on the machine, so that all inequalities caused by hardening or uneven wearing are corrected. The arbor on which the work is held, revolves on two dead centers to insure accuracy. The cooling water is under control at all

times and the supply can be increased or diminished and directed to the proper place on the work. Guards are provided for confining the water, but these do not obstruct the view of the work which is in plain sight of the operator. While this machine was primarily designed for grinding straight fluted hobs intended for cutting gears of the smaller pitches, an attachment for grinding spirally-fluted hobs can be supplied. Gear cutters, forming cutters, circular forming tools for screw machines, taps and similar tools can also be ground. The machine will accommodate diameters up to 5¾ inches. A one-speed overhead countershaft and all the necessary wrenches are furnished.

GREAVES, KLUSMAN 15-INCH ENGINE LATHE

Greaves, Klusman & Co., of Cincinnati, O., have brought out a new lathe that embraces a number of novel features in its design. This machine has ample power for heavy reduction work and it is also adapted to comparatively light work by its convenience of operation.

The bed of this machine is of a new design, and has been heavily reinforced under the V's by an extra thickness of metal which extends down below the girts. The side walls above the girts are three times as thick as below so that twisting strains of the V's or bed are minimized. The headstock is webbed its entire length and is equipped with a high carbon steel spindle that is accurately ground and runs in phosphor-bronze bearings.

Figs. 2 and 3 show phantom and sectional views, respectively, of a new design of tailstock which is so constructed that it admits a spindle one-third longer than the usual length. This spindle telescopes through a thimble at the rear

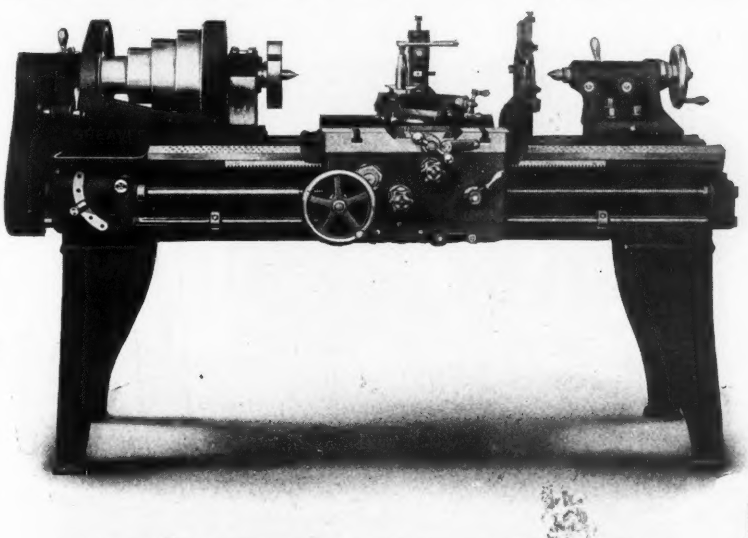


Fig. 1. Fifteen-inch Engine Lathe built by Greaves, Klusman & Co.

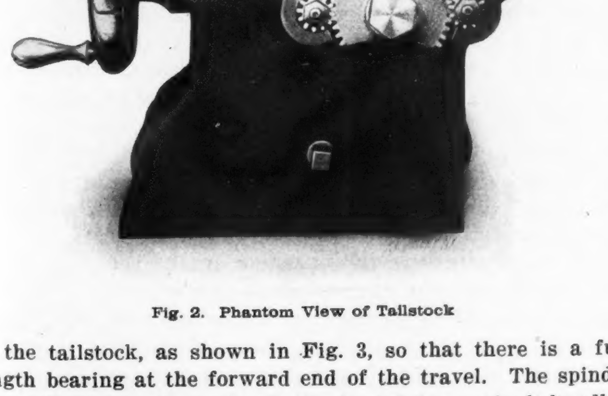


Fig. 2. Phantom View of Tailstock

of the tailstock, as shown in Fig. 3, so that there is a full length bearing at the forward end of the travel. The spindle is clamped at both ends of the barrel by a single-handled clamping device. When this handle is turned in the direction for clamping, the pinions shown, which are mounted on the clamping screws, are revolved, by means of toothed sectors on the handle, sufficiently to cause the spindle to be firmly gripped

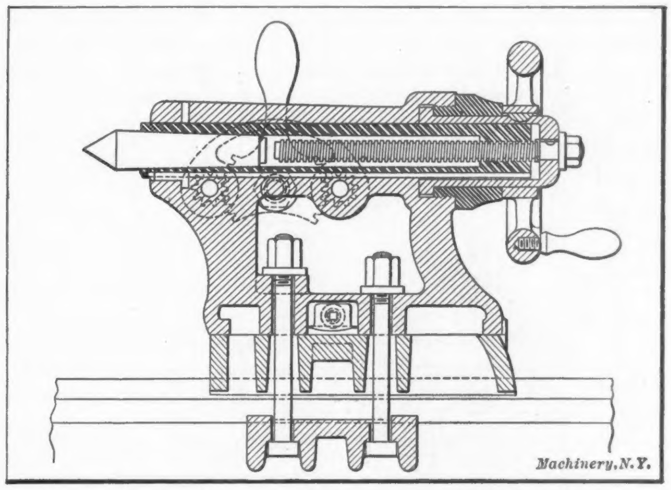


Fig. 3. Sectional View of Tailstock showing Method of Clamping and Spindle Construction

between sleeves that are curved to fit it. The tailstock is clamped to the bed by means of a double clamp having three bolts, two of which are located in front and one in the rear as indicated.

The carriage is extra heavy and it has a full length bearing on each of the V's. In place of the usual inner front V on the bed, a wide flat bearing is provided which gives a substantial support directly under the tool-rest and shortens the bridge of the carriage. For cross-feed work, the carriage can be locked by means of an eccentric clamp operated by a handle at the front. The compound rest is substantially built, and both cross-feed and top-slide are provided with taper gibs. The tool-rest and cross-slide screw collars are graduated to read in thousandths of an inch. The apron of this lathe, an inner view of which is shown in Fig. 4, is of the double-plate box form with bearings at each end for the studs. All gears are of steel and of coarse pitch. The longitudinal and cross feeds are operated by frictions and they are reversed by a lever at the front of the apron. The lead-screw and feed-rod cannot be engaged at the same time, and the latter is supported at each end of the apron so that it is kept in alignment regardless of the position of the carriage.

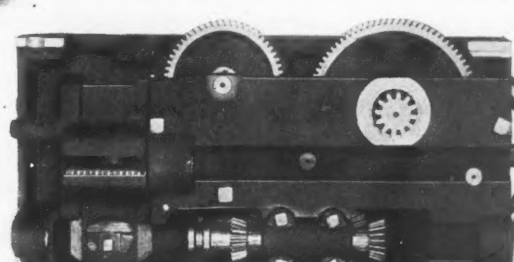


Fig. 4. Inner View of the Apron

The rack pinion can be disengaged when the lathe is to be used for screw-cutting, thus releasing all gearing and giving a free movement to the carriage. This lathe has a thread-cutting capacity ranging from 2 to 48, including 11½ pipe thread, and a chasing dial is provided which permits the thread to be "caught" at any point.

Five independent geared feeds, ranging from 10 to 160 are instantly available by simply shifting a feed lever located at the head end. These feed changes may be made while the lathe is running and the tool is taking a cut. The way the various changes are effected in shown in the sectional view Fig. 5. The power is transmitted from the spindle through

the shaft A to the shaft B, which is located inside the bed and on which gears of various sizes are mounted. Below this shaft there is a second shaft C, which is connected by gearing with the feed-rod and on which there is a pair of gears D_1 and E_1. These gears are keyed to shaft C but are free to slide on

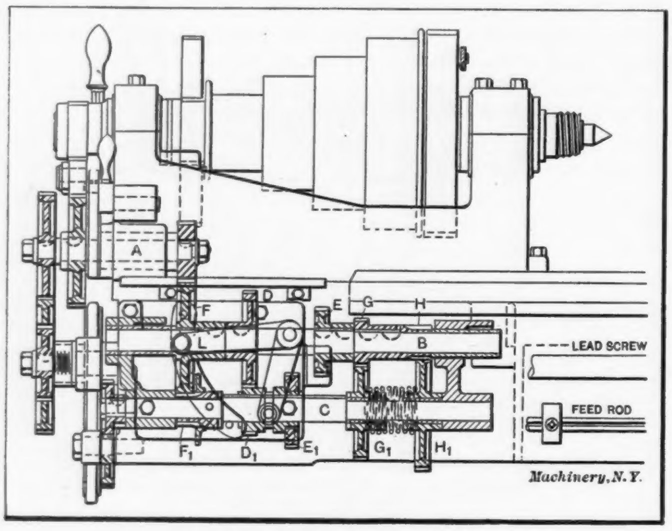


Fig. 5. Feed Changing Mechanism

it, and their position is controlled by lever L. When this lever is in the upper hole of its quadrant, a clutch on gear D_1 comes into engagement with the corresponding clutch on pinion F_1, which is in mesh with gear F and through which shaft C is driven. When lever L is moved to the second hole, as shown, the drive is through gears D and D_1, whereas a movement to the third hole brings into mesh gears E and E_1. A still further movement brings the clutches on E_1 and G_1 into engagement so that the drive is then through gears G and G_1. By moving the lever L to the last or lowest hole, G_1, which has clutches on both sides, is forced over against the tension of the spring shown, into engagement with gear H_1. When the gears are in this position, G_1 serves to connect E_1 with H_1, which is driven by the pinion H. In this way the five changes are obtained. All the feed gears are of steel, of coarse pitch, and run in an oil bath. The feed-rod is provided with an automatic stop in either direction.

This machine swings over the bed 16⅝ inches, and ovēr the carriage, 11¼ inches. The maximum distance between the centers with a 6-foot bed, is 36 inches. With a two-speed countershaft, there are sixteen changes of spindle speeds. As Fig. 1 shows, all the gearing is fully enclosed. The cover at the head end is hinged to permit changing the gears without difficulty. The regular equipment includes a compound rest, large and small faceplates, steady- and follow-rests, change gears, countershaft and wrenches. A plain rest can be substituted for the compound type if desired, and a taper attachment, turret on the carriage or shears, oil pan bed, pump and tubing, draw-in collet attachment, etc., can be supplied if required.

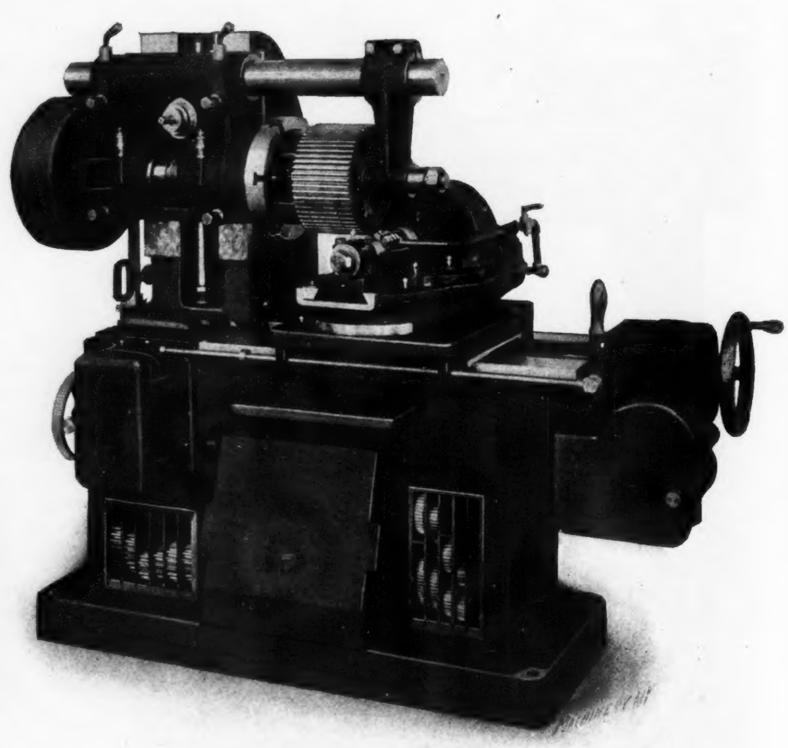
BARBER-COLMAN NO. 12 GEAR HOBBING MACHINE

The design of gear hobbing machine illustrated herewith is a recent development of the Barber-Colman Co., Rockford, Ill. This machine was designed strictly as a manufacturing tool for cutting accurate spur and spiral gears such as are required in the manufacture of modern machine tools, automobile transmissions, etc.

As the engraving shows, the work-spindle is horizontal and it is mounted in a slide that is vertically adjustable on the column for various diameters of gears. The cutter spindle, which is also placed in a horizontal position, is carried on a slide that is adjustable along horizontal ways on the bed. Attached to the work-spindle slide there is an overhanging arm, similar to the arm of a milling machine, on which is clamped a yoke for supporting the end of the work arbor. This yoke or support is provided with a bronze bearing in which runs a hardened sleeve clamped on the work arbor. The work-spindle is provided with long bearings which insure continued accuracy of alignment between the work arbor and the hob slide, and both the work and hob spindles run in conical bearings that provide practical means for compensating for wear.

The drive for this machine is of the direct single-speed belt type. The tight and loose pulleys are 14 inches in diameter, take a 3-inch belt, and run at 300 revolutions per minute so that it is possible to belt direct from the main line shaft or from a motor as desired. The speed changes are obtained by transposing gears at the front of the machine. The feed is positive, and any desired rate may be obtained by change gears. An automatic tripping mechanism is provided for disengaging the feed of the hob slide at any predetermined point in its travel.

As the slide on which the hob is mounted is in a horizontal position, it can be easily adjusted or swiveled to an angular position for cutting spiral gears. As the axis of the hob intersects the vertical axis of the swivel, the hob may be set for cutting spiral gears by first placing it in a central position with the work-spindle when at right angles to the latter or with the swivel set at zero, and afterwards swiveling it to the angle desired in the same manner that would be employed in setting for spirals on the milling machine. A lateral or



Barber-Colman No. 12 Gear Hobbing Machine

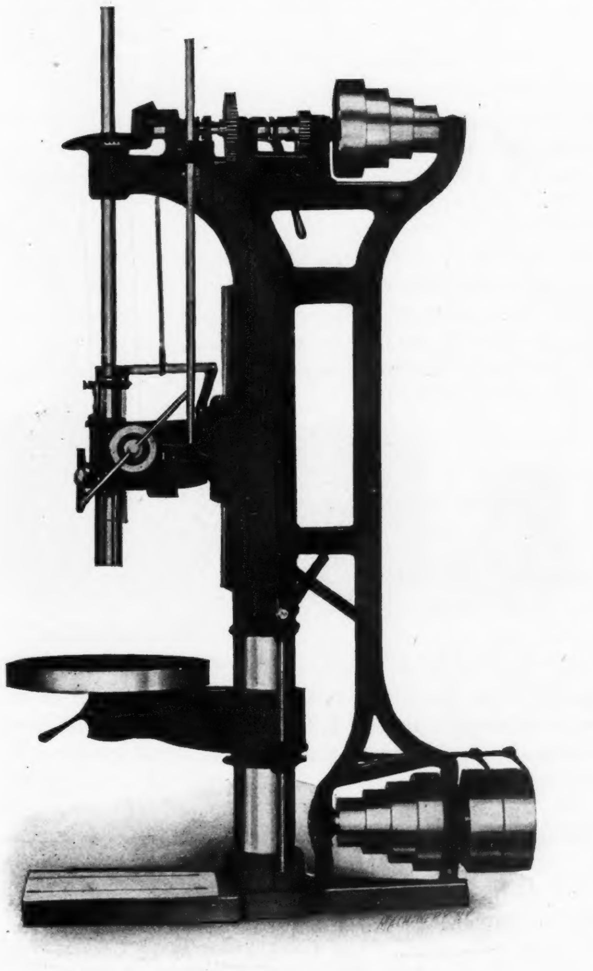
axial adjustment of the hob is obtained by a cross-slide on the swivel, which has sufficient movement to allow different teeth in the hob to be set central, so that each tooth can be brought into action and a maximum amount of work obtained from the hob before sharpening is necessary. The swivel base has an angular adjustment of 45 degrees on each side of the zero or right-angle position, and the graduations are provided with a vernier reading to 10 minutes. The machine is also equipped with a micrometer dial for accurately setting the hob to the correct depth.

All the bearings in this machine are bushed with bronze, and special attention has been given to lubrication. The lubricant for the hob is contained in a spacious tank cast integral with the bed, and an oil pump, regularly provided, is attached to the machine. All oil and chips are conveyed to a removable chip basin that is placed in the bed. The bed as well

as the upright for supporting the work-spindle, is of box section and rigidly constructed. The equipment consists of the necessary change gears for hobbing all gears ordinarily encountered, speed and feed change gears, wrenches, charts and feed tables. The net weight of the machine is approximately 3700 pounds.

GEARED FEED FOR SIBLEY DRILL PRESSES

The Sibley Machine Tool Co., South Bend, Ind., has designed a positive geared feeding mechanism which is to be applied to the entire line of Sibley drill presses above the 20- and 22½-inch sizes. The accompanying illustration shows a 28-inch sliding-head drill equipped with this new feed. The power is derived from the horizontal driving shaft at the top of the machine. This shaft is connected through spur gears and spiral gears to a vertical feed shaft. At the lower end of this vertical shaft, connection is made with the feed box proper which is located on the head of the drill press. The feeding movement is transmitted from the vertical shaft through bevel gears to a horizontal shaft in the feed box on which is mounted a cone of four gears that mesh with an equal number on the worm-shaft. The feed changes are effected by means of a small knob conveniently located in the center of the handwheel. This knob is connected with a sliding key which, by engagement with different gear combinations, gives four feed changes. This key can also be shifted to a neutral position. The gear case which encloses the feed mechanism is designed to be partly filled with oil so that thorough lubrication is insured. As all the shafts in the case are in a horizontal position, all the parts are well lubricated with the case one-third full of oil. By means of an automatic stop collar on the sleeve of the spindle, a latch which holds the feed worm in mesh with the bronze worm-gear is thrown out of engagement, thus causing the entire mechanism, which is fulcrumed on a large hinge pin, to swing down. This feed mechanism is geared down step by step, in such generous ratios from the initial drive, that an unusually powerful feed is obtained.

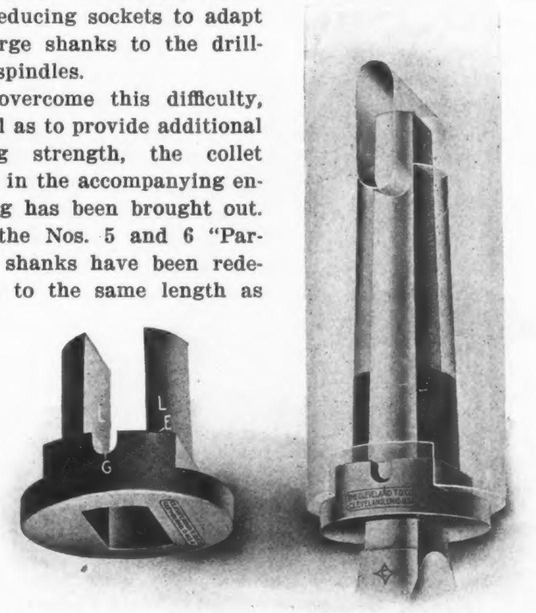


Sibley Drill Press with Positive Geared Feed

COLLET FOR DRIVING FLAT TWIST DRILLS

The Cleveland Twist Drill Co., Cleveland, O., has recently applied for patents on a new device for driving high-speed twist drills of the type that have flat taper shanks which are tapered both on the flat sides and round edges. Shanks of this kind are regularly furnished on the "Paragon" flat twist drills made by this company. The drive for these drills has been by sleeves or sockets having flat taper holes accurately fitting the shanks and externally tapered to fit standard taper sockets for the spindles. In the case of flat twist drills of large diameter having No. 6 shanks, this drive was found to have certain disadvantages, as it made necessary the use of cumbersome extension reducing sockets to adapt the large shanks to the drill-press spindles.

To overcome this difficulty, as well as to provide additional driving strength, the collet shown in the accompanying engraving has been brought out. Both the Nos. 5 and 6 "Paragon" shanks have been redesigned to the same length as regular taper shanks, the taper on the round edges being the regular Morse taper as formerly. When this modified shank is inserted in the spindle, its upper end is received and driven by the flat slot in the spindle just as is the tang of an ordinary taper shank drill. This alone would constitute a strong and practical drive, were it not for the fact that the shank would lack support at the lower end of the spindle. By the use of this new form of collet, a powerful additional drive is given to the shank at its lower end where the cross-sectional area is greatest.



"Paragon" Collet for Driving High-speed Flat Twist Drills

As shown in the illustration, this collet consists of two lugs *L* which project upward from a disk-like body through which is cut a rectangular hole to receive the drill shank. These lugs are ground on the outside to a standard taper and the inner surfaces are tapered to fit the flat taper shank. The view to the right shows the collet, drill shank and spindle in combination. As will be seen, the extension *E* which projects from the base of the collet, mortises into a slot cut across the end of the spindle so that the collet is rigidly held in place, and the entire combination is practically an interchangeable taper shank with an unusually long tang.

The width of projection *E* is such as to conform to the standard slots now being put in the spindles of heavy-duty drill presses by several well-known manufacturers. Collets made without this extension will fit any spindle or socket and will be furnished to those having machines with spindles not fitted with slots, when specified, but they will not, of course, have the same driving strength as the regular type. A groove *G* is provided to receive the point of a drift-key in case the collet should stick in the spindle.

That this tongue and groove drive at the large end of the shank is much stronger than any drive on the tang, is evident from an inspection of the engraving.

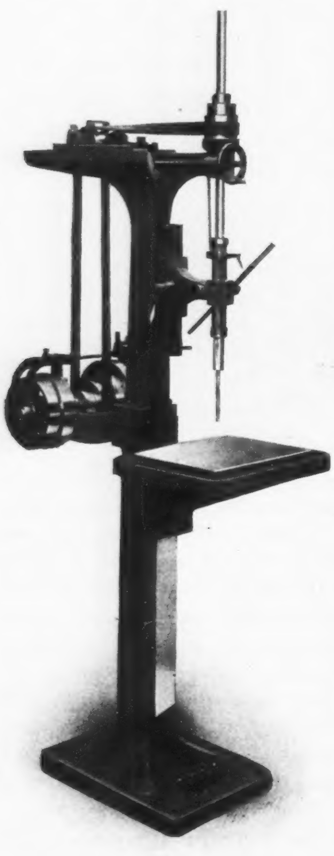
AVEY NO. 1 SENSITIVE DRILL PRESS

The ball-bearing drill press illustrated herewith is a recent design that has been brought out by the Cincinnati Pulley Machinery Co., Cincinnati, O. The machine, which is known

as the "Avey No. 1," has ball bearings throughout, permitting it to run at the highest speed that high-speed twist drills will stand. The bearings are constructed on the four-point contact system, and all ball races and cones are of steel, hardened and ground.

Four changes of speed are obtained from a 4-step cone pulley, which drives a single pulley on the spindle. The adjustment of the belt, when changing the speeds, is taken care of by means of a carriage on the top of the column, on which are mounted two idlers. The movement of this idler carriage is effected by a screw-rod and handwheel which is located in front of the machine at a point convenient to the operator. The advantage of this screw connection with the carriage, in addition to the quick and convenient adjustment, is in the positive and precise belt tension it affords. In changing from one size twist drill to another, if a change in belt tension is required, it can be obtained by a slight turn of the handwheel.

When making speed changes, the cone pulley is shifted longitudinally on its shaft in order to bring the step to be used into alignment with the spindle. This adjustment is easily made, and without the use of wrenches. It will be noted that the loose or idler pulley is smaller than the tight one, which relieves the tension on the belt and reduces wear on the countershaft bearings when the machine is not in use.



High-speed Ball-bearing Drill Press

This drill press is designed to handle work within the limits of No. 1 taper shank drills, which range in size up to 37/64 inch. The spindle is of crucible steel and accurately ground. The spindle sleeve is graduated and the stop collar, which is mounted on it, may be set directly by these graduations for drilling holes of any predetermined depth. This stop collar has a fixed clamping screw so that no wrench or screw-driver is required. The rack pinion and shaft for the feed lever, is in one solid piece, which is a decided advantage over the construction in which a sleeve is held in place by a set-screw. The upper and lower columns, as well as the countershaft on this machine are tongued and grooved, which assures permanent alignment. The spindle is 7/8 inch in diameter, it has a traverse of 12½ inches, and is bored to receive a No. 1 Morse taper. If desired, an elevating device can be furnished for the table. This device, which can be applied at any time, is practically the same as those used on milling machines, there being a telescopic screw operated through bevel gears.

This machine is built with any number of spindles up to and including 4. The distance between the spindle centers of a multiple-spindle machine is 9 inches. The tables range in size from 15 by 18 inches for the single-spindle machine, to 15 by 43 inches for the four-spindle type.

ALLEN SAFETY SET-SCREWS

The danger attached to the use of the set-screw having a projecting head is well known, as this type has been directly responsible for an appalling loss of life. An excellent substitute for it, which has the required strength and gripping power without the dangerous element, has been placed on the market by the Allen Mfg. Co., Inc., 135 Sheldon St., Hartford, Conn.

In Fig. 1 a sectional view of this safety type of set-screw is shown and also the kind of wrench that is used. These screws are made from high-test steel bars and are said to be able to withstand more strain than the projecting-head type of screws of the same diameter. In the process of manufacture these screws are turned from the solid, drilled, and then swaged over a mandrel to form the hexagon hole for the wrench. This hole is neatly and accurately finished so that the wrench, which is simply a bar of hexagonal steel bent at right angles, will have a good hold. The points of these screws are backed up by a thick wall of metal so that when hardened and drawn, they will stand up under any pressure that can be applied with the wrench. If desired, the leverage of the wrench can be increased by the use of a piece of pipe or a monkey wrench. Any pressure within the capacity of the wrench can be applied, as the screw cannot break if it fits the hole. If a lock is required a second set-screw is screwed in on top of the first, thus effectually locking it in place. A screw that is slightly shorter than the depth of the hole should ordinarily be used, and when these screws are employed on marine work or in a damp place, the hollow head should be filled with beeswax or a mixture of beeswax and tallow, to prevent rust.

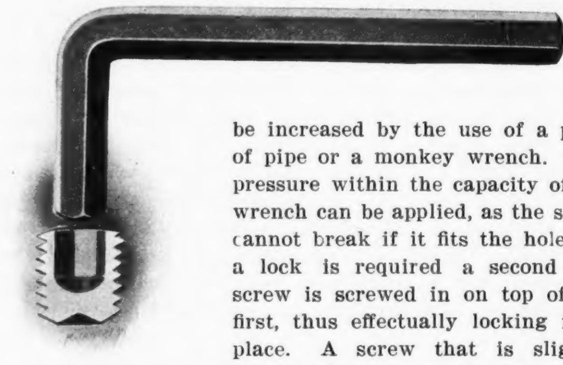


Fig. 1. Allen Safety Set-screw and Wrench

In Fig. 2 a cast-iron test piece is shown that was broken by the pressure exerted with one of these set-screws. This piece is 1¼ inch square and has a ¾-inch tapped hole extending through it. When the test was made, set-screws were inserted in each end of the piece with a plain cylindrical steel block between them. One screw was then tightened until the test piece was broken as shown. To effect such a break, a pressure of approximately 8 tons was required, but this excessive pressure on the screw failed to distort the end or cause it to "mushroom" in the hole. This company will eventually bring out a full line of machine screws with hollow hexagon heads.

Fig. 2. Test Piece Broken by Pressure Applied with Safety Set-screw

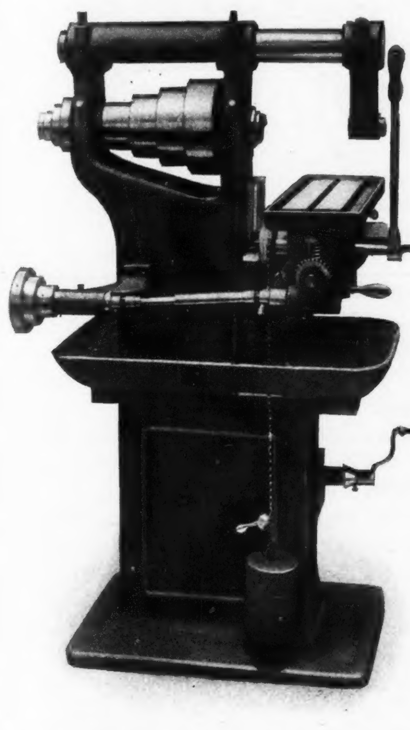
BICKFORD AND WASHBURN NO. 1 MILLING MACHINE

The milling machine illustrated herewith has been designed by its builders, Bickford & Washburn, Inc., Greenfield, Mass., to meet the demand for a plain miller of medium size and price. This machine has several important features which should appeal to manufacturers who want to increase the efficiency of their equipment.

The table has a power feed and a hand lever is also furnished to provide a rapid hand feed for light work. The feeding movement is transmitted to the table through a worm-wheel, kept in constant mesh with a rack which is a quarter section of a screw. This construction gives a smoothness of cut not obtained with the ordinary rack-fed machine, and the tendency to chatter is prevented by the curved teeth of this screw rack. The worm-gear meshing with the rack, is driven by a short worm which is mounted on a shaft that is rotated through worm-gearing and a feed shaft of the regular type.

Another feature of this machine is the provision for imparting a quick return movement to the carriage when the feed stops. This is often desirable, especially when the machine is being used for such work as fluting taps or reamers. This quick return of the table is effected by means of a short drum mounted on the cross-shaft which carries the worm-gear meshing with the table rack. As this drum revolves, it winds up a wire cable to which is attached a weight. When the feed is released, this weight immediately falls and returns the machine table by unwinding the cable. The exact place at which the table will stop is varied by means of a special clamp by which the length of the cable is easily adjusted.

A crank handle is used interchangeably on the elevating screw, cross-feed and table feed, and the screw for the latter is provided with a device for keeping the crank from falling off. Both the elevating and cross-feed screws have graduated collars which may be set in any position. The entire feed mechanism is protected by a guard not shown in the illustration. The table has a T-slot through its center for ⅝-inch bolts and a large oil channel extends around it. The edge of this channel is planed off flush with the platen.



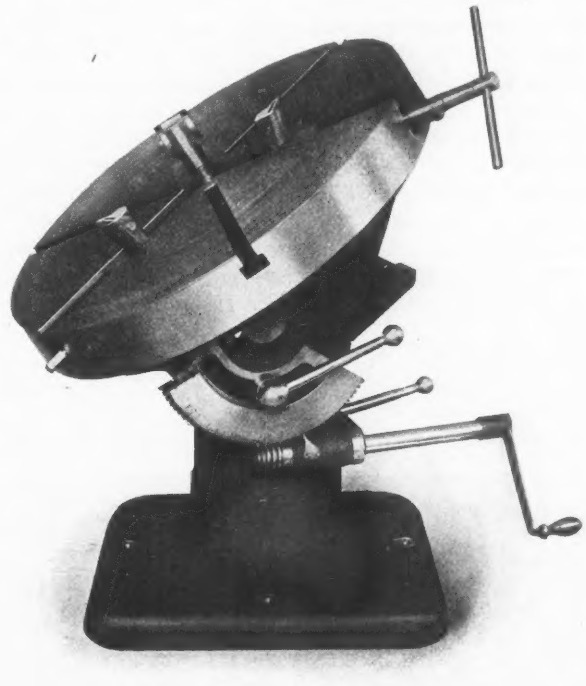
Bickford & Washburn No. 1 Milling Machine with either Hand or Power Feed

This machine weighs 900 pounds. The working surface of the table is 8 by 23½ inches and it drops 7½ inches from the center of the spindle. The table has a horizontal movement of 15 inches, a vertical adjustment of 7 inches, and a cross-feed of 3 incnes. The spindle, which is bored for a No. 10 Brown and Sharpe taper, runs in bronze bearings that are adjustable for wear. For supplying lubricant, either an oil drip-cup or pump will be furnished. When the latter is supplied, the tank is placed in the base.

This machine is to be built in two sizes designated as Nos. 1 and 2. The No. 2 machine will be nearly identical with the No. 1 size shown in the illustration, the principal difference being an increase of about 600 pounds in weight and the addition of back-gears.

GANG UNIVERSAL DRILL PRESS TABLE

The auxiliary drill press table shown in the accompanying illustration is built by the William E. Gang Co., Cincinnati, O. This table, which is equipped with a chuck attachment, is fully universal in its adjustments and therefore adapted to a wide variety of work. The upper part on which are located all the operating levers, can be swiveled in a complete circle about the base. In addition to this movement, the chuck can also be revolved upon its center irrespective of the angle to which it is tilted. This tilting movement is effected by a crank which operates a worm meshing with a toothed segment of large diameter. This segment is graduated from zero to ninety degrees so that the operator can set the table accurately to any desired angle. The three-jawed independent chuck shown is 26 inches in diameter and is adapted to hold work of a round or irregular shape. This chuck was originally designed for drilling copper tuyeres for blast furnaces, or work of a similar nature. For chucking castings that are tapered either on the inside or outside, the jaws are equipped with adjustable faces that will accommodate themselves to any taper within wide limits. These faces are provided with springs that keep them tilted back toward the center of the chuck so that work having a tapered bore can be easily placed on the jaws, thus making it necessary to loosen only one jaw when removing or placing work in the chuck. The chuck jaws are reversible and if desired they can be re-



Drill Press Table with Universal Adjustments

moved, thus converting the chuck into a round table. When the chuck is used in this way, the three T-slots shown can be used for clamping. This table can be furnished with a plain top, either round or square in shape, instead of a chuck. The plain round top has the same diameter as the chuck—26 inches—and the square table measures 24 inches across.

ANDERSON GEAR ROLLING MACHINE

A process for forming gear teeth by the molding-generating method or by rolling the blank in contact with an accurately cut toothed roller, has been developed by H. N. Anderson, chief

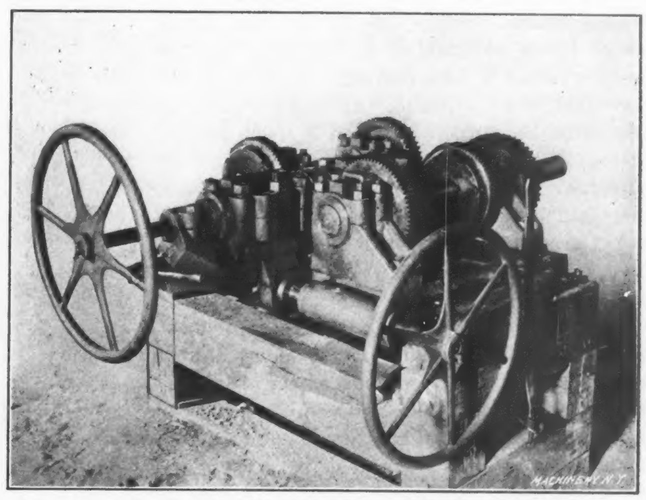


Fig. 1. Machine for Forming the Teeth of Gears by a Rolling Process

engineer of the Speedwell Motor Car Co., Dayton, O. The machine which has been designed for forming gear teeth by this method, is shown in Figs. 1 and 2. The blanks to be rolled, which are made slightly larger than the pitch diameter of the finished gear, are first heated to a forging heat, after which they are placed in the machine and clamped firmly between two arbors which are timed by a gear of the same size as the one to be rolled. The carriage holding these arbors is then swiveled to bring the heated blank into contact, first

with a breaking-down roller in which are V-shaped teeth that cause the metal to flow out into a larger diameter than tne finished gear. The carriage is then moved to bring the blank into engagement with the finishing roller which develops the shape of the teeth; at the same time, any surplus metal flowing out at the ends of the teeth is removed by a trimming tool.

The construction and operation of this machine will be understood by reference to Fig. 3, which shows a plan view. The roughing and breaking-down rollers R and R_1 are mounted on shafts S and S_1 that are connected by gears E, F and G of the same size, so that both rollers rotate at the same speed. The shaft S_1 is the driver, and it is connected to the work arbor by gears C and D. The blank B is clamped between enlarged ends on the arbors, which bear against the web of the blank and fit into recesses of large diameter formed in each side of the gear, thus giving it a firm support. The clamping action is effected by the handwheel H. The carriage on which the work arbors are mounted, is free to swivel on a pivot which is located in line with the rear faces of gears C and D.

When a gear is to be formed, the heated blank, after being clamped in place, is forced into contact with the breaking-down roller R by means of the handwheel H_1. During this preliminary rolling operation, the carriage is swiveled, as shown

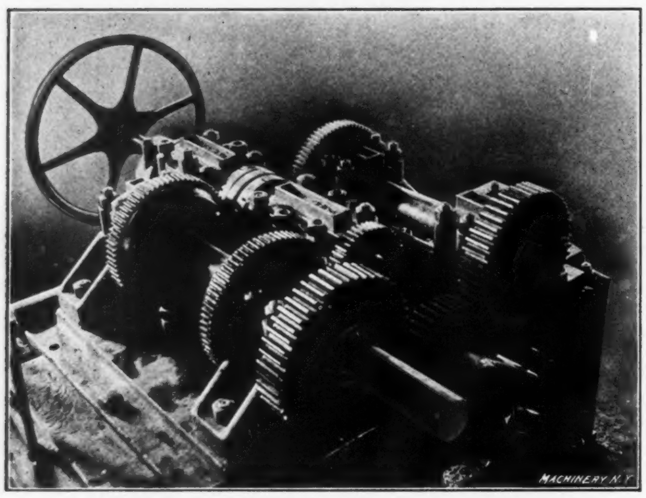


Fig. 2. Another View of the Gear Rolling Machine

in the illustration, so that the axes of roller R and the blank are not parallel. For this reason roller R is made slightly conical so that the teeth will be parallel with the periphery of the blank. When the teeth have been rough rolled sufficiently, as indicated by the positive stop K, the carriage is swiveled to the right, thus bringing the blank into contact with the finishing roller R_1, which continues the forming operation until further movement is prevented by the stop N. After the teeth have been finished in this way, the work arbors are adjusted longitudinally in first one direction and then the other to bring the sides of the rotating blank into contact with the trimming tools T, which remove the "flash" or superfluous metal at the ends of the teeth. The ends of the work arbors between which the blank is clamped, are provided with a stripping arrangement which enables the finished gears to be removed without distortion.

It will be seen from the foregoing that gears C and D, through which the work arbor is positively rotated, are shifted out of engagement somewhat when the blank is being rolled, by the swiveling action of the carriage. By locating the pivot on which the carriage turns, in line with the rear faces of these gears, as stated, they have a normal contact when the blank is swung around into engagement with the finishing roller R_1. The number of teeth formed in the blank is, of course, governed by the size of gear D, which has to be changed for different sizes. When such a change is made, the pivot for carriage J, as well as the plate M on which the roughing roller is mounted, will also have to be adjusted.

In order to minimize slight imperfections which might exist in the toothed rollers, the gears C and D are so proportioned, in this particular case, that the blank makes 73 revo-

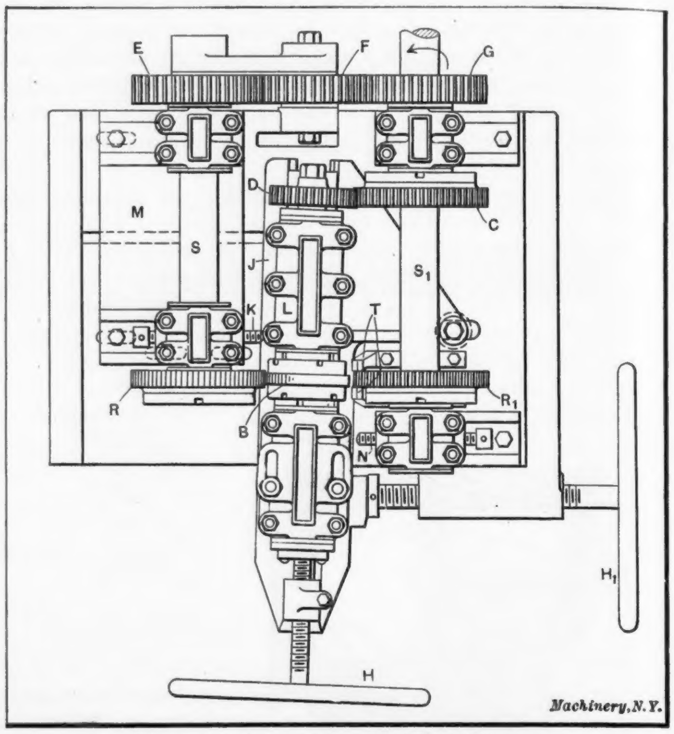


Fig. 3. Plan View of the Gear Rolling Machine

lutions before a given tooth on the roller enters a given space in the blank a second time. The product is also improved by reversing the direction of rotation after the rolling process has been practically completed.

In Fig. 4 samples of gears rolled in this machine are shown. The one to the left still has the flash at the ends of the teeth, while the other has been trimmed.

The advantages claimed for this process are as follows: cheapness, as the actual rolling operation does not exceed 45 seconds per gear; strength and superior wearing qualities, owing to the pressure exerted on the faces of the teeth in rolling which makes the metal dense and gives the faces a hard outer shell. By removing the blanks from the heating furnace at a uniform temperature, the shrinkage can be

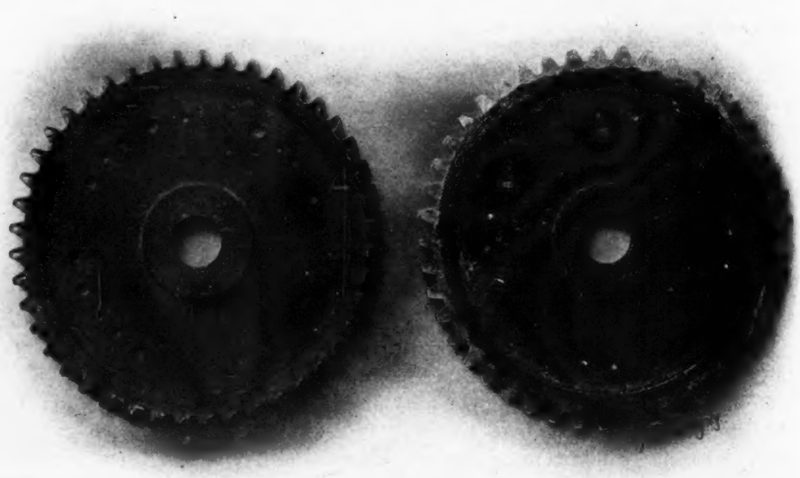


Fig. 4. Rolled Gears before and after the Flash is trimmed from the Ends of the Teeth

gaged, and it is claimed that the accuracy of the finished rolled gears is equal to that of those which have been cut and casehardened. The tendency of the rolled gear to warp in casehardening is also less than with the cut gear, as the structure of the metal at the periphery is changed while hot, so that there are no internal strains to be righted in the casehardening operation, which is likely to be the case with a cut gear, which is operated cn with the metal in a cold state.

These gears are intended to be used in connection with automobile work for differentials and transmissions on the cheaper classes of cars, without being finished or timed after the rolling operation. For more accurate work, they could also doubtless be finished advantageously by grinding, after having first been rolled slightly over the finished size.

HIGH-SPEED GEARED 16-INCH DRILLING AND TAPPING MACHINE

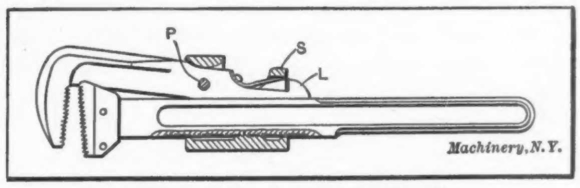
The accompanying engraving shows a new design of drilling and tapping machine, which is being placed on the market by the Frontier Iron Works, Grant and Letchworth Sts., Buffalo, N. Y. One of the interesting features of this machine is the geared driving mechanism for the spindle. This mechanism is contained in the circular case shown attached to the head. On the pulley or driving shaft a disk 8½ inches in diameter is mounted in which are inserted three rows of hardened steel pin teeth of involute form. The inner of these rows has thirteen teeth, the center row, twenty-four teeth, and the outer row, thirty-four teeth. On the spindle two pinions are mounted, which are held in position by yokes connected to a tube shown on the outside of the case in the illustration. When the upper of these pinions is in mesh with the teeth, on the disk, the spindle revolves in the direction for drilling, whereas the engagement of the lower pinion gives it a reverse movement for backing out taps. As there are three rows of teeth, in the driving disk, three changes of speed are available and the changes are instantly obtained by adjusting the vertical tube to the correct position.

Frontier 16-inch Drilling and Tapping Machine

This machine will drill holes of any diameter up to and including ¾-inch, and it has a maximum tapping capacity of ⅝ inch. When the machine is being used for drilling, the lower pinion is shifted to a neutral position between two rows of teeth on the driving disk. All speed changes can be made while the machine is in motion. The table is slotted so that jigs, etc., can be bolted to it. The maximum distance between the spindle and table is 36 inches. The traverse of the spindle is 4½ inches, its diameter in the sleeve is 1⅛ inch, and it is bored to conform to a No. 2 Morse taper. The column is 4 inches in diameter, and the over-all height of the machine, 78 inches. This machine is rigidly designed throughout and is adapted for manufacturing and repair shops.

WRIGHT QUICK-ADJUSTING PIPE WRENCH

In the department of New Machinery and Tools for April, 1910, we described a quick-adjusting pipe wrench which was brought out by J. F. Wright, Canton, O. This wrench has since been considerably improved, the design having been changed as shown by the accompanying line engraving. The commendable features of this wrench are its simplicity, ease of adjustment and strength. It can be gripped to or released from the work quickly and it is easily adjusted to different sizes with one hand, the adjustment being made by simply depressing the sleeve *S* with the thumb; this disengages a pawl in the sleeve from a rack on the under side of the handle. The movable jaw has a rocker action independent of the yoke and the latter also has a similar action that is independent of the movable jaw. The lug *L* on the end of the movable jaw relieves the pivot *P*, which is simply intended for holding the parts together when the wrench is not in use, from all strains



Wright Quick-adjusting Pipe Wrench

and also equalizes the strains over the entire length of the yoke. By inserting a match in place of the pivot *P*, it has been demonstrated that there is no strain on this pivot when the wrench is in action.

PLANT INSIDE MICROMETER CALIPER

The Emerson Apparatus Co., 251 Causeway St., Boston, Mass., is now manufacturing the inside micrometer caliper shown in Fig. 1. This micrometer is a primary instrument as it is graduated to give direct readings in thousandths of an inch, without the use of an outside micrometer caliper. By estimation even finer measurements can be obtained. This caliper consists of a set of two tools each of which has two screws for different ranges of measurement. The smaller

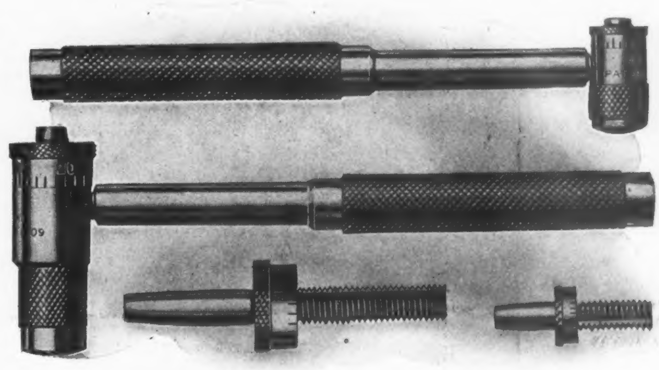


Fig. 1. Plant Inside Micrometer Caliper

of these tools with its two screws has a capacity for measurements ranging from ½ to 1 inch, inclusive, whereas the larger size, with its two screws, will take measurements ranging from 1 to 2 inches.

The construction of this caliper is shown in the sectional view Fig. 2. The barrel or body *A* of the instrument holds the measuring screw *B*, which telescopes into the barrel. This measuring screw is advanced from the barrel by means of a graduated nut *H*, and it is prevented from rotating when being adjusted, by a locking pin *E*. The pin is held in the end of the handle and it is pointed to fit a V-slot in the meas-

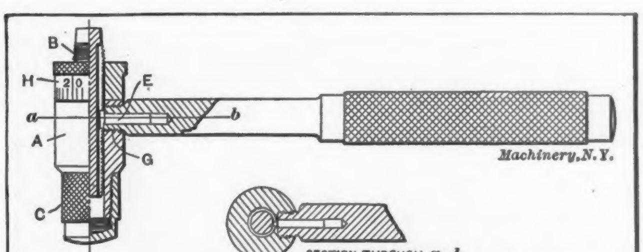


Fig. 2. Sectional View of the Plant Caliper

uring screw with which it meshes. By a slight rotation of the handle which is threaded into the barrel, this pin is brought to bear on the measuring screw and in this way the latter is locked after an adjustment has been made. The periphery of the adjusting nut *H* is graduated and each graduation, in passing the index mark on the barrel, indicates a movement of 0.001 inch of the measuring screw. Every revolution of the nut advances the screw 0.025 inch and after every fourth revolution, a tenth of an inch graduation appears

on the slot in the measuring screw just above the upper edge of the nut. To the lower end of the barrel, a knurled cap *C* is fitted that may be used for making slight adjustments to compensate for wear. All parts of this micrometer, with the exception of the measuring screws, are hardened. It is adapted to either tool-room or general shop work for taking accurate measurements in connection with boring, slotting, grooving and internal work in general.

FAY & SCOTT 16-INCH GEARED HEAD LATHE

A new design of single-belt drive, friction geared-head lathe, having instantaneous spindle speed variation is shown in Fig. 1. This machine is the product of Fay & Scott, Dexter, Me. The drive is through a single constant-speed pulley located at the back of the headstock. This pulley is designed to be belted direct to the lineshaft, and power is transmitted to the spindle through gearing, thus relieving it of all belt pull. The headstock, a plan and elevation of which are shown in Figs. 2 and 3, has four mechanical speed changes that are effected by means of friction clutches. These frictions are of the expanding type, fitted with cork inserts and operate as follows:

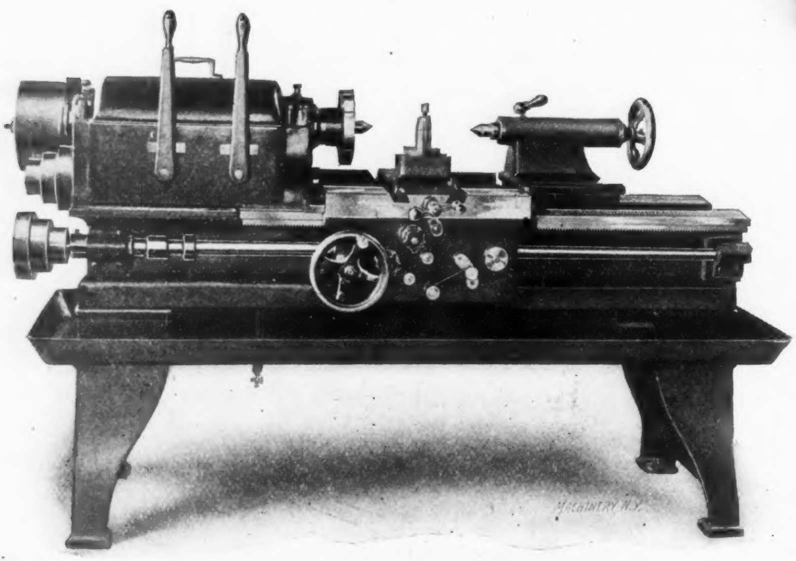


Fig. 1. Fay & Scott 16-inch Geared Head Lathe

The sleeve *A*, carrying gears *B*, *C* and *D*, is driven at a constant speed, turning on shaft *E*. Four gears, *F*, *G*, *H* and *J*, are mounted on four friction bands, *K*, which turn loosely on the spindle *L*, and may be clutched to the spindle by four frictions, *M*. These gears are always in mesh with the gears on sleeve *A*, and drive the spindle at four speeds. Gear *N* meshes with *C* and is driven by the pulley *O* through reducing gears which are located on shafts *P* and *Q*, as shown in the plan view, Fig. 2.

The speed changes are controlled by means of the two vertical levers that are shown mounted at the front of the headstock. These speed changes may be made while the machine is in motion and without any shock to the gears, the engagement of two conflicting ratios of gearing at the same time being made impossible. The entire mechanism runs in a bath of oil and is practically noiseless in operation. The working parts are readily accessible, and the friction clutches have a single adjustment that may be made with a screw-driver.

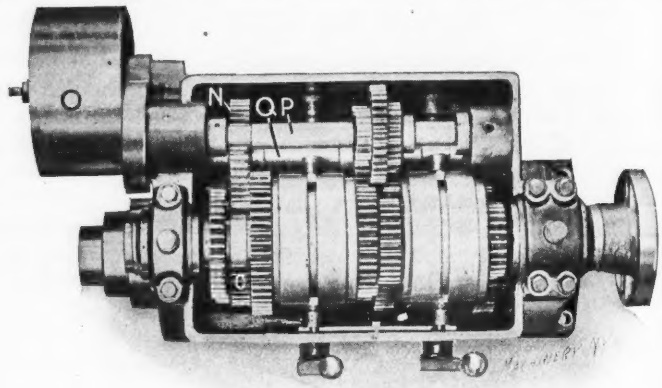


Fig. 2. Plan of Fay & Scott Geared Head

The particular machine shown is fitted up for plain turning with the usual rest, and with the screw-cutting feature omitted. It can, however, be furnished with facilities for screw-cutting and with a compound rest.

Modern features have been incorporated in the design, snuch as hollow hammered-steel spindle with ground bearings; bronze boxes; cut-away type of tailstock; wide waist carriage; flat inside front bearing, and a double-plate apron of the bevel gear type. This apron has reverse feeds and there is a positive lock-nut for the feeds when the machine is arranged for thread cutting. If desired, a taper attachment can be supplied and a turret can also be fitted to the carriage or V's.

As this machine was designed for the special purpose of turning cams of different sizes, four spindle speeds only were necessary. By the use of a two-friction countershaft, however, the speeds can be doubled, or by using a countershaft of the variable-speed type any desired number of speeds can be obtained.

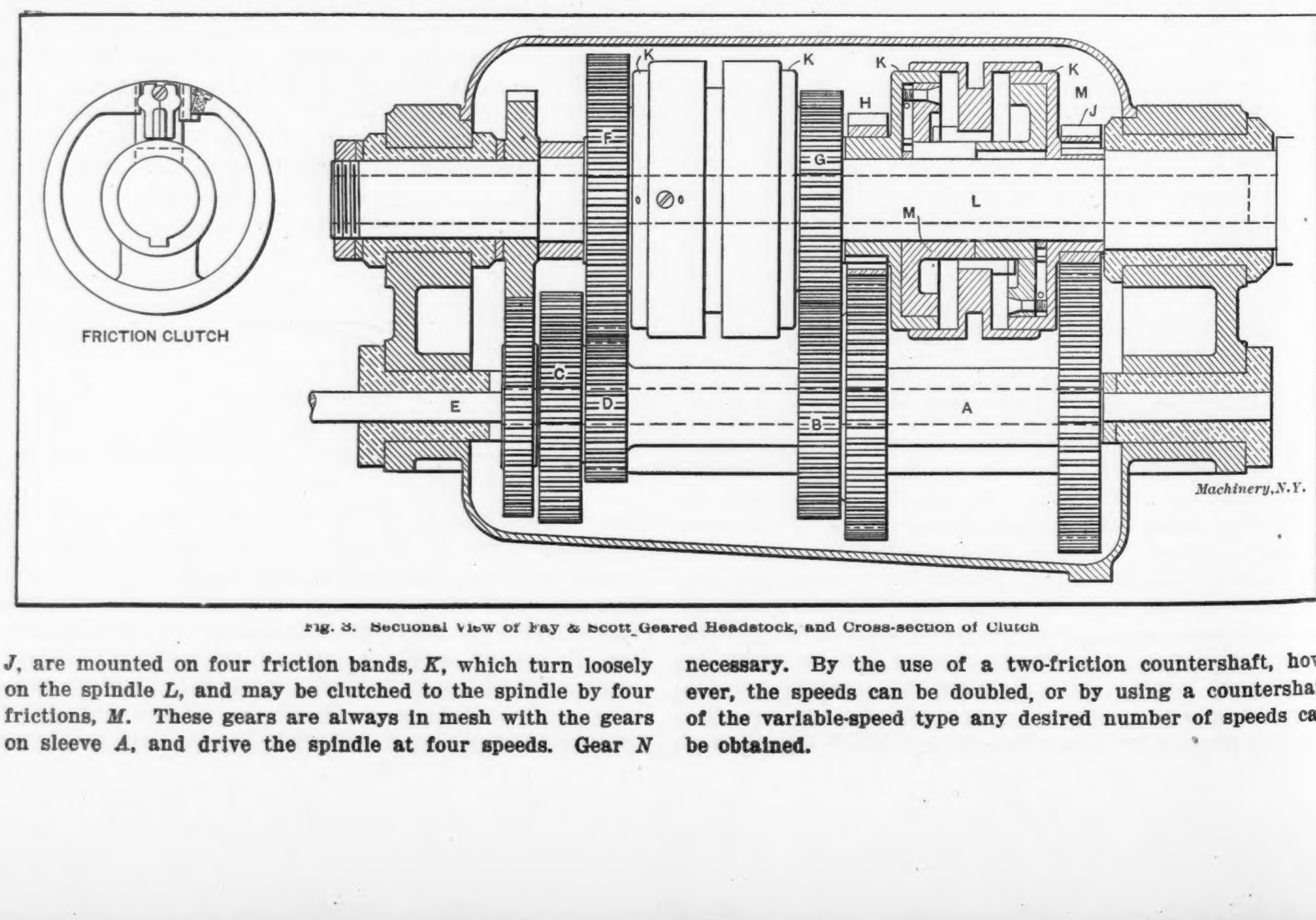
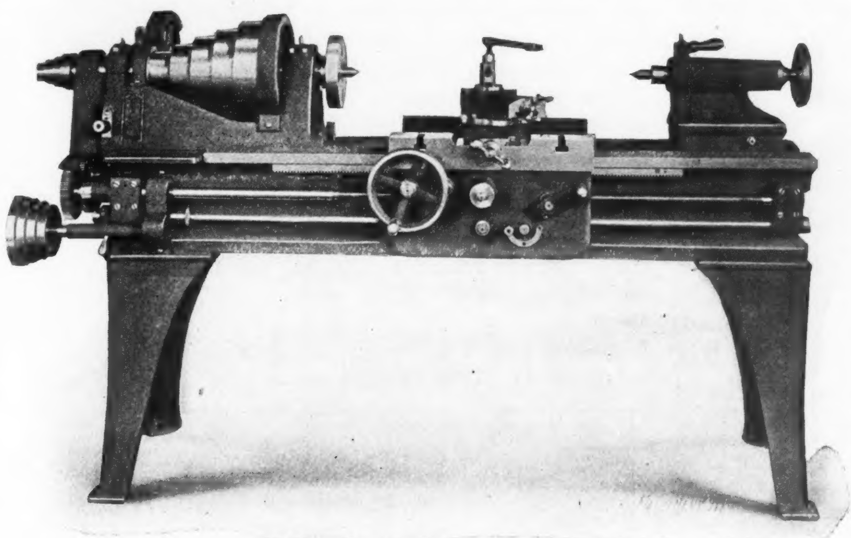


Fig. 3. Sectional View of Fay & Scott Geared Headstock, and Cross-section of Clutch

ROCKFORD 15-INCH LATHE

The 15-inch engine lathe shown herewith is a product of the Rockford Tool Co., Rockford, Ill. This lathe has been designed to meet the requirements of tool-room work and manufacturing. It is strictly high-grade throughout and is heavily constructed and well ribbed, so as to stand up under heavy cuts. The spindle is made of high-grade spindle steel and it runs in phosphor-bronze bearings. The front bearing is 2⅝



Rockford Tool Co.'s 15-inch Lathe

inches in diameter by 4 inches long, and the rear bearing has a diameter of 1 15/16 inch and a length of 3 inches. A hole 1⅜ inch in diameter extends through the spindle. The particular lathe illustrated is equipped with a 5-step cone and a single backgear with a ratio of 10 to 1. This lathe is also built with double backgears and with a 3-step cone, when it is to be used on work requiring considerable power. The headstock is of a heavy pattern that is well braced, and the faceplate supplied with the machine is heavy and well ribbed to prevent any springing action when work is clamped to it. The bed is also heavily constructed and well ribbed and the webs in the sides are located directly under the shears to prevent any springing or chattering when taking heavy cuts. The shears have a large bearing surface and the carriage is gibbed in the front and back. The apron is well ribbed and is so constructed that the split nut and feed cannot be thrown in at the same time. The feed-screws for the cross-slide and the compound rest are both graduated. The opening in the tool-post is ¾ inch by 1½ inch. The tailstock is very rigid and the tail spindle is 1 15/16 inch in diameter and has a travel of 6 inches. The centers have a No. 3 Morse taper. Either a belt feed or a positive geared feed may be employed, there being a geared connection between the lead-screw and feed-rod which is readily thrown into or out of engagement. The thread-cutting capacity of this machine ranges from 3 to 20 per inch, including 11½ threads, and every other number from 20 to 40 per inch. The necessary gear changes for screw cutting can be quickly made without the use of wrenches, there being a special construction which enables this to be done.

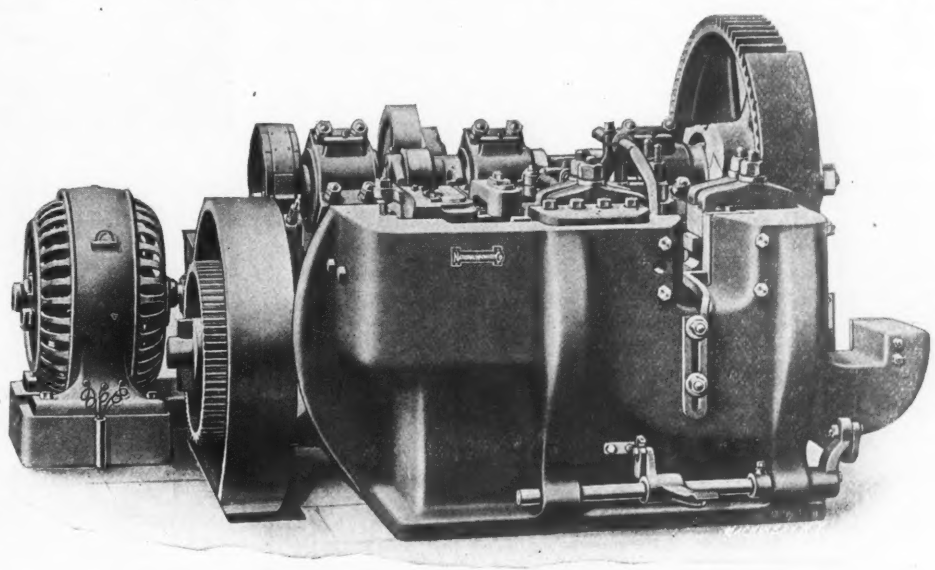
NATIONAL FORGING MACHINE WITH FRICTION SLIP FLYWHEEL

Among the many new and improved designs shown at the recent exhibition of bolt, nut and forging machinery, held by the National Machinery Co., Tiffin, Ohio, August 19 to 23, none attracted more attention or proved of greater interest than the "National" line of improved forging machines. The new features in particular were the "friction slip" flywheel design and the direct motor drive construction.

The "friction slip" flywheel, while simple in detail, meets a positive requirement in forging machine construction. It is a protection or relief to the machine against the enormous strains thrust upon it by the flywheel momentum when the machine "stalls," or, in other words, is prevented from completing the revolution due to an excess of stock or cold metal fed into the dies. The flywheel is held between friction flanges which are keyed to the shaft. When excessive material or cold stock is fed into the machine and prevents the heading tool from completing a full stroke, the flywheel slips between these friction flanges. This slipping action dissipates the momentum of the wheel, eliminates the excessive strains attendant to a rigid flywheel and protects not only the machine but the motor as well.

In the "National" direct motor drive design the motor is secured to a bracket bolted to the machine bed. The motor pinion meshes with a gear bolted to the "friction" flywheel. The design insures long life and protection to the motor and freedom from petty repairs, and has proved under the most severe tests to be a most practical method of directly connecting a motor and forging machine.

The double cam mechanism operating the grip is an interesting feature, also. This double cam mechanism allows the



National Forging Machine with Friction Flywheel and Improved Gripping Mechanism

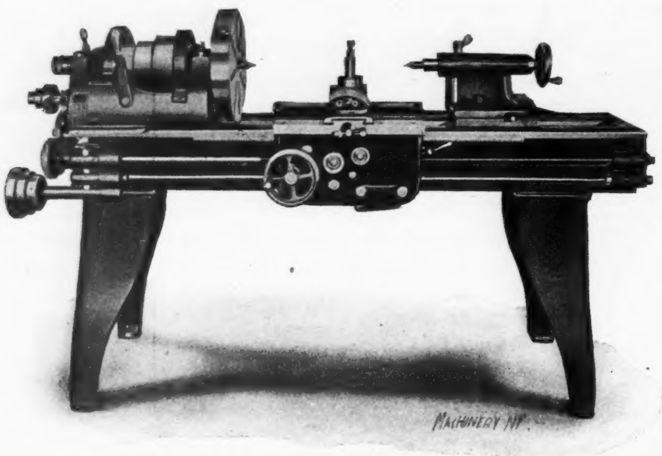
opening and closing of the dies to be "timed" so as to give unusually large upset or "gathering" capacity and this makes possible a wide range of work and more intricate forgings in fewer operations.

These machines are built in sizes of 1½-, 2-, 2½-, 3-, 3½-, and 4-inch capacity. The illustration is of a 2-inch machine and shows the motor application and "friction slip" flywheel plainly at the left.

MONARCH 16-INCH ENGINE LATHE

The Monarch Machine Co., of Sidney, O., has recently added to its line of machine tools the 16-inch engine lathe shown herewith. This lathe is equipped with double back-gears that are operated by a conveniently located lever. The headstock has a three-step cone and it is strongly ribbed. Either a positive geared feed or a belt feed can be employed and the range is sufficient to cover all practical requirements. The spindle is made of high carbon hammered crucible steel and it is ac-

curately fitted in bronze bearings. The tailstock is of the offset pattern which permits swinging the compound rest parallel with the bed. The bed has extra weight and depth and is webbed in 19-inch sections which insures rigidity. The carriage and apron are of modern construction throughout. The compound rest has a bearing surface of ample width and is provided with gibs for taking up wear. The steel rack used is in one section, and the pinion meshing with it can be disengaged for screw cutting. The ratios of the back-gears on this machine are 9 to 1 and 5 to 1. It has an actual swing

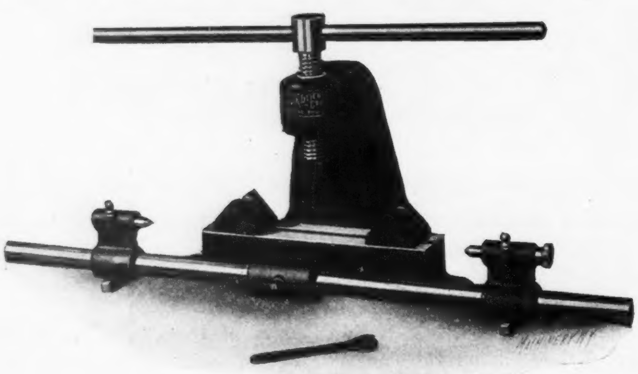


Sixteen-inch Engine Lathe built by Monarch Machine Co.

over the bed of 16 inches and over the plain and compound rests of 10 inches. The maximum distance between the centers with a 6-foot bed is 34 inches. The parts included in the regular equipment are a friction countershaft, a full set of gears, large faceplate, dog-plate, steady-rest, follow-rest and the necessary wrenches. All lathes are drilled to receive a taper attachment which can be furnished with the machine, if required.

GEIER NO. 1 STRAIGHTENING PRESS

The bench straightening press shown herewith is now being manufactured by the P. A. Geier Co., 5112 St. Clair Ave., Cleveland, O. This press, which is a No. 1 size, is designed for straightening shafts, arbors, forgings, spindles, and similar work. It has a capacity for straightening cold stock of 2 inches in diameter. The body is of box-type pattern, heavily reinforced to withstand the unusual strains to which tools of this kind are often subjected, and all parts are heavily constructed to give the press the required rigidity and power.



Geier Bench Straightening Press

Adjustable centers are attached directly to the press, as shown, so that centered work, which is being straightened, may be tested. The bracket supporting the centering shaft serves also as a hand-rest for holding the chalk when testing. The V-blocks, on which the work is supported, are easily adjusted along a groove in the bed. The thrust-block on the screw is of machinery steel, casehardened, and the adjustable centers are of tool steel and hardened. The body of the No. 1 press is 13 inches high; the length of the centering shaft, 40 inches, and the net weight, 135 pounds.

ACME TURRET LATHE TURNING TOOLS

The Acme Machine Tool Co., Cincinnati, O., has brought out a new line of turning tools for the Acme turret lathes. These tools are made to fit the 1½-inch and 2½-inch machines and the respective tools have a capacity equal to the spindle opening of the lathes for which they are intended. The back-rests are made of either the roller or plain type as desired. One of these tools of the roller-rest type is shown in Fig. 1, and also in Fig. 2 attached to a turret. As the engravings show, these rollers are mounted on dovetailed slides that can readily be adjusted for different diameters by the knurled screws shown. When the rollers are set, means are provided for locking them in position. The tool-block is fulcrumed on a large pin so that it can be swiveled to different positions. This block is clamped in place by the lever

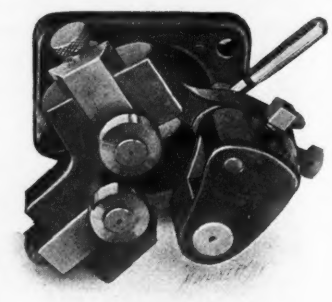


Fig. 1. Acme Turning Tool with Roller Rests

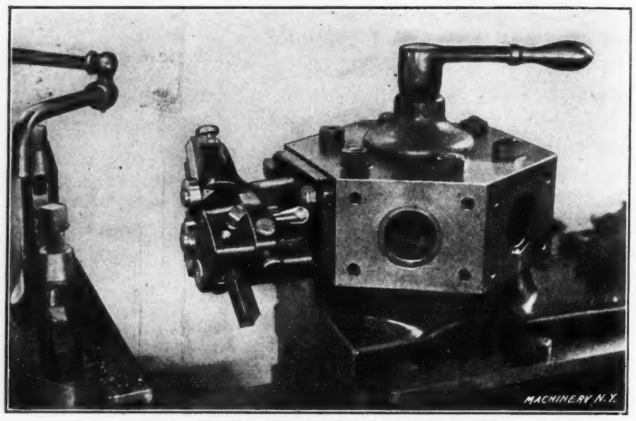
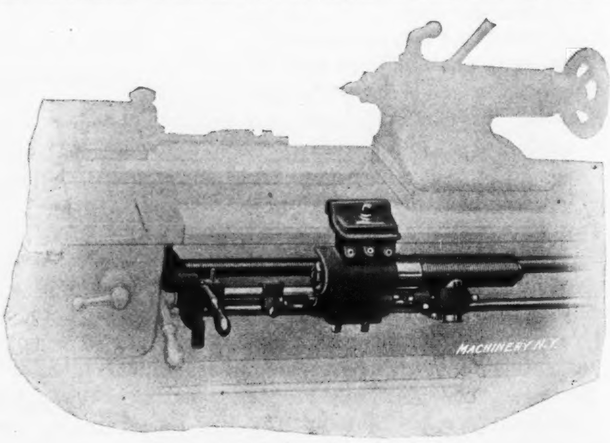


Fig. 2. Turning Tool Attached to the Turret

shown, which is attached to a screw tapped into the tool-block. This screw passes through a radial slot in the base casting. When the block is set in the proper position and clamped, it is securely held by a knurled backing screw, which, in turn, is prevented from turning by a locking screw.

HENDEY QUICK-THREADING ATTACHMENT

An interesting and valuable attachment, known as a quick-threading attachment, has recently been designed by The Hendey Machine Co., Torrington, Conn., and applied to the company's Hendey-Norton lathes. The attachment, as the name indicates, is intended for rapid thread cutting. Its use



Hendey Quick-threading Attachment

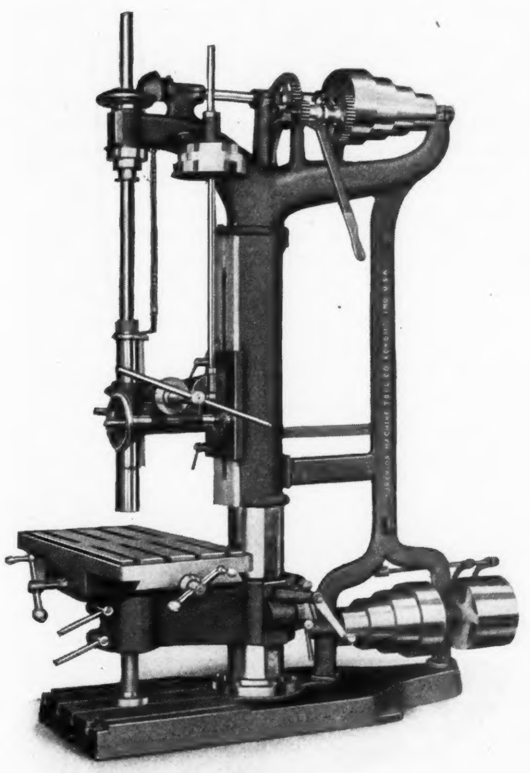
is especially advantageous on work where threads averaging from one to three inches in length are to be cut, but this is not the limit of the application of the attachment, the maximum capacity of which is a threaded length of 6 inches. The attachment, as shown in the accompanying illustration, con-

sists of a feed and a reversing sleeve, both assembled in a main bracket, a rocker shaft with rocker, and an operating lever with supporting bracket. In addition, two sets of trip dogs are provided, the pins of which engage with pins in the main bracket and act as automatic stops. A suitable chip guard is provided for the sleeves.

The principal advantage of this device is the saving in time over ordinary methods, which is due to the high speed at which the carriage is returned from the end of the cut to the starting point. This high speed is obtained by means of the quick-return sleeve which has a multiple thread of very coarse pitch. Both the quick-return sleeve and the feed sleeve are in constant rotation when the attachment is in use, the feed sleeve being driven from the reversing sleeve by spur gearing, the latter sleeve, in turn, being driven by the lead-screw. No time is lost when one of the sleeves is thrown in and the other thrown out of gear. This advantage will be all the more appreciated when contrasted with the ordinary method of reversing everything from the countershaft down. When the attachment is not used it is easily disconnected and can be moved out of place to the foot end of the bed. The attachment can be furnished for any of the Hendey-Norton 14-, 16- and 18-inch lathes, either for English or metric pitches.

SUPERIOR 32-INCH UPRIGHT DRILL

The Superior Machine Tool Co., of Kokomo, Ind., has added to its line of drilling machinery the 32-inch machine shown in the accompanying illustration. This drill press is equipped with a compound table which has both cross and longitudinal adjustment. The feed-screws, by which these adjustments are effected, have graduated dials reading to the thousandth



Superior 32-inch Upright Drill

part of an inch. The table has a working surface of 18 by 36 inches and its dimensions over-all are 20 by 40 inches. The arm is of heavy design having an exceptionally large bore for the table, which is rigidly supported by an adjustable supporting screw that rests on the base. This machine has been especially designed for handling automobile parts and for the use of railroad shops.

* * *

Radium has slightly decreased in price and it is now stated that it costs about $2,100,000 per ounce. This is less than it was a year ago, when it was estimated at about from **$2,500,000 to $3,000,000 per ounce.**

NEW MACHINERY AND TOOLS NOTES

Combination Forge and Furnace: C. U. Scott, Davenport, Ia. Combination forge and furnace with heating space of 4 by 9 inches. The design is such that the work does not come in direct contact with the blast, thereby greatly reducing the formation of scale.

Brazing Outfit: Gilbert & Barker Mfg. Co., Springfield, Mass. Fuel oil brazing torch and stand for holding work. A mixture of fuel oil and air is used in the burner, in which combustion is completed, so that a flame free from smoke is directed upon the work.

Bench Torch: C. U. Scott, Davenport, Ia. Torch for bench use which can be operated either with city or gasoline gas and air at $1\frac{1}{2}$ pound pressure. A stand 10 inches high is provided for holding the burner, and the latter can be adjusted to the most convenient height.

Steel Pulleys: Oneida Steel Pulley Co., Oneida, N. Y. Steel pulleys ranging in size from 6 to 126 inches in diameter and with face widths varying from 2 to 40 inches. By means of a system of interchangeable cast-iron bushings these pulleys may readily be fitted to any one of several sizes of shafting.

Adjustable Reamer: Lapointe Machine Tool Co., Hudson, Mass. Large adjustable reamer 10 inches in diameter, intended for reaming cylinders. The body is made of machinery steel and the inserted blades are of high-speed steel. A $4\frac{1}{2}$-inch hole extends through the body in which a $\frac{3}{4}$-inch keyway is cut for fastening the reamer to an arbor. The weight of this reamer complete is 92 pounds.

Hydraulic Wheel Press: Logemann Bros. Co., Milwaukee, Wis. Hydraulic wheel press which is operated by a triple two-stage pressure pump that is adjusted to respond automatically to the requirements of the service either at high or low pressure. This automatic control of the pressure meets the changing degrees of resistance and prevents sudden and severe strains which might result in breakage.

Steam or Air Hammer: Buffalo Foundry & Machine Co., Buffalo, N. Y. Improved design of steam or air hammer built in four sizes. The weights of the falling parts are, respectively, 250, 450, 700 and 1500 pounds, and the cylinder diameters for the different sizes are 6, 8, 10 and 12 inches. The valve gears of the two larger sizes have been redesigned, the oscillating valve formerly used having been replaced by a balanced piston valve.

Rotary Slitting Shear: Niagara Machine & Tool Works, Buffalo, N. Y. Rotary shear in which the widths of the strips to be cut are regulated by a gage which may be rapidly adjusted. Anti-friction rollers on the face of the gage, reduce the friction between the gage and stock, which, in turn, reduces the friction on the cutters and increases their wearing qualities. A holding-down attachment is provided which bears upon the stock as it passes through the machine.

Profile Truing Device: S. A. Woods Machine Co., Boston, Mass. Truing device for wood-working planers that sharpens and correctly forms the knives while running at full speed. This device corrects the inaccuracy of grinding and setting and insures an equal cut for the knives. When this attachment is in use, the holder carrying the truing stone is caused to automatically rise and fall in its movement across the machine, by a profile or pattern plate so that all cutters are accurately trued and made to "track" perfectly.

Annealing Furnace: Hawley Down Draft Furnace Co., 736 West Monroe St., Chicago, Ill. New type of annealing furnace known as the Hawley automatic. A special feature of this furnace is the automatic operation, it being driven by an electric motor controlled by a clock, so that all work to be annealed is kept in the furnace for a definite time according to the character of the work. The furnace is fed from an overhead hopper and can thus be kept in continuous operation without much attention.

Universal Grinder: Modern Tool Co., Erie, Pa. No. 3 universal grinder of rigid design. The body is nearly as long as the ways so that the latter have practically no overhang and are therefore evenly supported throughout their entire length. A smooth steady movement is given the reciprocating table by simplified worm-gearing and large bearing surfaces. The reversing mechanism is mounted on a bracket which is bolted to the outside of the machine so that it can be easily removed if necessary.

Milling Machine Drive: Garvin Machine Co., Spring and Varick Sts., New York City. Milling machine drive so designed that the motor can be applied to a stock machine, thus avoiding expense and delay. The motor is mounted preferably on a bracket at the rear, and drives by belt to a high-speed 2-step cone, which is connected to the countershaft on top of the column. By means of back-gears, sixteen changes of speed are available. The countershaft is mounted in eccentric bearings which may be rotated by a segment worm-gear to vary the belt tension.

Jolt Ramming Machine: Arcade Mfg. Co., Freeport, Ill. Large jolt ramming machine especially designed for handling

heavy loads and large flasks. This machine is built in three sizes, the smallest of which has a table 6 by 10 feet with a ramming load capacity of 40,000 to 45,000 pounds. The largest has a table 6½ by 12 feet with a ramming load capacity of 55,000 pounds. Tables of greater length can be furnished if required. The table is actuated by three pneumatic cylinders, the pistons of which operate in unison. The stroke is ¾-inch and the air pressure is 80 pounds.

Measuring Machine: Pratt & Whitney Co., Hartford, Conn. Large precision measuring machine with capacity up to 144 inches. To eliminate error in the microscopic readings, the standard bar has been elevated to a position nearly level with the surface of the bed. The delicacy of contact between the measuring faces is obtained by the use of auxiliary jaws holding a small cylindrical drop-plug by the pressure of a light helical spring. The tension of this spring is so adjusted that the instant the clamping surfaces are brought into perfect contact, the plug, which is held in a horizontal position by friction, will swing toward a vertical position and excess pressure will cause it to drop out.

Sheet Metal Straightener and Cutter: F. B. Shuster Co., New Haven, Conn. Sheet metal straightening and cutting machine for strip metal up to 14 inches in width and 0.065 inch thick. The cutting-off mechanism is electrically controlled and may be operated either automatically by a stop gage or with an electric button located at the front of the machine. The metal passes through the feed and straightening rolls and between the cutting-off knives to the gaging table. As it comes in contact with the gage, an electric connection is made which engages the cutting-off mechanism and at the same time stops the movement of the rolls. The severed stock is delivered to a rack or suitable receptacle.

Four-slide Milling Machine: Garvin Machine Co., Spring and Varick Sts., New York City. Special four-slide milling machine especially adapted for such work as the cutting of oil grooves in automobile axles, keyseating, fluting, notching, squaring ends, etc. The machine has four slides or work-tables which may be operated independently so that there are practically four machines. With this construction, three slides may be at work continuously while the fourth is being loaded. There is one cutter spindle for each pair of slides and this is also independently driven so that one slide can be entirely disengaged when required. The slides may be fed by hand or power and twelve changes of feed are provided.

Carborundum File: The Carborundum Co., Niagara Falls, N. Y. Carborundum file adapted to the work of a steel file and also for filing parts which a steel file could not cut. This file is made of a solid block of carborundum 13 inches long, 1½ inch wide and 1½ inch thick. One end is rounded and the other is fitted with a durable wooden handle. It is claimed that this file will work much more quickly on castings or soft metals than one of steel, and in addition it may be used for touching up casehardened parts and also for removing the scale from hard metals. Owing to the extreme hardness of carborundum, this file has excellent wearing qualities and it cuts fast and clean and does not glaze or wear smooth. The size and shape, as well as the grade of abrasive used, are such as to adapt the file for all-around work.

Machine Recorder: National Machine Recorder Co., Marquette Building, Chicago, Ill. In the department of New Machinery and Tools for October, 1908, we described an instrument for recording automatically the length of time machine tools are idle or in operation. This machine has recently been improved by the addition of an adding attachment, a time-setting device, and a set of production counters. The adding attachment accurately and automatically computes the net running or idle time of each machine. Each producing unit in the shop has an adder which shows distinctly in large figures the net time that the machine has been producing or, if desired, the idle time together with the total at the end of the day. The time-setting device, when set to a fixed time for an operation, records on a chart and adding wheels such time as is consumed in excess of the given time. A set of production counters, placed directly above the time adding attachment, records each piece produced by each machine as it is finished, so that there is an accurate record of the output, time consumed, and time wasted.

Circular Milling Machine: Barber-Colman Co., Rockford, Ill. Eighteen-inch circular milling machine of the vertical type intended for finishing small parts such as links, levers, connecting-rods, universal joints, clutch-yokes, etc. The machine is equipped with a circular table which may be revolved continuously and to which the work is clamped radially in suitable fixtures. After each piece is milled, it is removed and replaced with an unfinished part so that the milling operation is continuous. The machine is not designed for circular work, though such work can be handled conveniently, but for the single purpose of machining those pieces that can be milled with face, side or straddle mills. The construction of the machine is high-grade throughout. All running bearings are bronze bushed and are generously proportioned. The spindle is of crucible steel and it has a No. 11 taper hole in which the shanks of arbors or end mills can be held. The nose is also slotted for positive driving and the end threaded for the larger sizes of face mills. The drive is of the direct gear type, and six changes of speed are provided. The table is rotated through worm-gearing and it also has six feed changes. This machine occupies a floor space of 44 by 66 inches, and it has a net weight of 3300 pounds.

Gear Tooth Chamfering Machine: Ingle Machine Co., Rochester, N. Y. Machine for chamfering the ends of teeth on all styles of gears, including those of the internal type. The operation is performed automatically on any gear within the machine's capacity regardless of pitch or number of teeth. The chamfering is effected by a rotary motion of the gear being cut, combined with a reciprocating movement of the slide in which the cutter spindle is mounted. The machine is driven by two belts from a countershaft, one driving the cutter spindle and the other the feeding mechanism. The feed is varied for different metals and pitches by a cone pulley which provides three changes. Provision is made for swiveling the cutter head to the right or left, depending on which side of the gear is to be chamfered, and the head is also adjustable. All gears are located in the cutting position by a guide or stop and no adjustment of the work is necessary after the machine is once set up. This machine will take gears ranging from 1½ to 12 inches in diameter and with diametral pitches of from 12 to 4. The equipment furnished includes an oil pump, all necessary fittings, two double cutters, an arbor, complete countershaft and the required wrenches.

Vertical Surface Grinder: Blanchard Machine Co., Cambridge, Mass. Vertical surface grinder equipped with a rotary work-table or magnetic chuck, which forms an integral part of the machine. This chuck is mounted on a sliding table which may be quickly adjusted clear of the wheel to place and remove work. The work-table runs on a ball bearing of large diameter; it is securely gibbed down by a ball thrust bearing at the center. The massive construction of the head and spindle has made it practical to mount the driving pulley or drum directly on the spindle which is driven by a 5-inch double belt from an overhead countershaft. The spindle is mounted on a sliding bar that is secured to vertical ways on the column. This head has a rapid power traverse which is operated by a conveniently located lever. Over travel in either direction is prevented by a simple device which positively returns the operating lever to a neutral position when the limit of travel is reached. The splined shaft which drives the table through bevel and spur gears, is, in turn, driven by a constant-speed pulley through a gear-box giving eight speed changes. The levers for the speed variations and also for starting and stopping the table are conveniently located. The cooling water is supplied by a submerged centrifugal pump which forces it through pipe and hose connection, and suitable channels, to the inner face of the wheel, whence it is driven across the ground surface in a rapidly-moving sheet, thus effectually cooling the work. All important bearings in this grinder, as well as all continuously running gears (except the pump gears) have oil bath lubrication. The grinding wheel used in this machine is 16 inches in diameter and the rotary magnetic chuck has a diameter of 24 inches. The maximum height under a new wheel is 12 inches. The net weight of the machine is 6800 pounds.

Planer: Knecht Planer Co., Cincinnati, O. Electrically-driven planer in which the table reversal is effected by means of gearing, the driving belt and pulley running continuously in one direction. The drive is such that the power is independent of that used for the return movement of the table, so that different cutting speeds with a constant return can be obtained. The drive is by belt from an electric motor on the housing to the main driving pulley. The reversing belt, which is shifted in the regular way, is located on the left side of the machine. The reversing pulley, like the main driving pulley for the cutting stroke, runs in one direction only. This reversing pulley is held by a ratchet and pawl mechanism during the cutting stroke, and it is released at the end of the cut just before the reversing belt is shifted to the pulley. As the latter starts as soon as released, it is in motion at the time the belt is shifted which relieves the motor of heavy loads. The feed mechanism is positive and independent of the driving mechanism. The feed is actuated by a clutch which is tripped at each end of the stroke. The feed boxes through which the feed movements are transmitted, are mounted on each end of the cross-rail so that the feed can be controlled from both sides. The feeds range from 1/64 to 3/4 inch, increasing by 64ths and any desired amount can be instantly obtained by shifting a conveniently placed lever. A handle at the top of the feed-box provides means for engaging or disengaging the feed without disturbing the setting either as to amount or direction. By means of a handle at the center of each feed-box, a fast traverse may be transmitted to the slide that is connected for feeding. This feature saves considerable time particularly when setting or testing work. If desired, this planer

can be equipped for belt drive in which case the countershaft is mounted on the cross-tie between the housings, in place of the motor. Four tool-heads are provided and those on the side are counterweighted.

* * *

WRECK OF WELLMAN'S DIRIGIBLE BALLOON "AMERICA"

Walter Wellman, the newspaper man who achieved international notoriety a few years ago by making an attempt to reach the North Pole in a dirigible balloon, essayed to cross the Atlantic in the same type of flying machine in October. The start was made from Atlantic City, October 13, in the *America*, a dirigible balloon 228 feet long carrying Wellman and a crew of five—besides the cat. The balloon was provisioned for a long trip and carried an ample supply of gasoline for the engines. The project was backed by three newspapers in London, New York and Chicago, to whom wireless messages were to be transmitted by a Marconi apparatus on board. A novel feature of the equipment was the "equilibrator," a long snake-like appendage to the car consisting of gasoline containers attached to a wire cable. The function of the equilibrator was to maintain the balloon at a constant height and to assist in steering. The tail end floated in the sea, and as the balloon rose above a predetermined height more of the equilibrator weight would be carried and as it descended, less of its weight would be supported. Thus it was expected that a constant mean height would be automatically maintained without the expenditure of gas and ballast. The equilibrator was a development of the leather "snake" stuffed with food which was to be dragged over the ice on the proposed North Pole expedition, but which was never given an adequate trial because of the wreck of the balloon before it was well under way. The daring, not to say foolhardy, navigators, were caught in a great storm and blown out of their course in a southwesterly direction, but fortunately were rescued about 400 miles off Cape Hatteras by the steamer *Trent*, bound for New York, on October 18. The equilibrator was condemned as being unsatisfactory. The action of the heavy waves transmitted severe shocks to the car and threatened the destruction of the whole fabric. Thus endeth the last of a long series of experiments with the dirigible balloon, a device that must necessarily be the sport of the winds, no matter how powerful the engines or how skillful the navigator. By good fortune Wellman might have succeeded in crossing the Atlantic, but the exploit would have proved little, and would have been of little practical value.

* * *

THOMAS DAVENPORT, INVENTOR OF ELECTRIC MOTOR

A tablet was unveiled in memory of Thomas Davenport in Forestdale, town of Brandon, Vermont, September 28. The inscription on the tablet reads:

"In memory of Thomas Davenport, 1802-1851. Inventor of the electric motor. Near this spot stood the building where he developed his invention. This tablet is placed here by the allied electrical associations in America in recognition of the great service rendered mankind by the invention, to the development of which he devoted his life. Erected September 28, 1910."

Davenport's father died when the boy was ten years old, and he was apprenticed to a blacksmith in Forestdale. In one corner of the old blacksmith shop he arranged a crude experimental laboratory where he conceived the idea of transmission of intelligence by wire before Morse invented the telegraph. He produced here the first electric motor before there was a mile of steam railway in Vermont, and built and operated a model electric railway. Later he moved to New York to perfect his inventions. While in New York he drove a printing press with an electric motor and published an electric journal known as the *Electric Magnet* and later as the *Magnet*. Both these publications expired after a few issues. Broken in health and financially ruined, he returned to Vermont where he died July 6, 1851. Davenport's inventive career was one of discouragement and misfortune. His inventive genius was of a high order, but unfortunately he was ahead of his time and the world was not ready to accept and develop his ideas and reward him financially as it has later inventors who conceived practically the same inventions.

THE USE OF BALL OR ROLLER BEARINGS IN MACHINE TOOL CONSTRUCTION*

The author of the paper abstracted in the following stated at the outset that he hesitated considerably about accepting the call to address the machine tool builders on the subject of ball or roller bearings, not because he had not a great deal to say about this subject, but because he knew full well how difficult it was to get below the machine tool builder's hide the idea that there could be anything in ball bearings for him. Then however, he remembered that the machine tool builders had all prospered, and hence were familiar with the ball bearings in their automobiles.

In the following no discussion of the merits of ball bearings in general or of various types and designs will be given, but rather a brief reference to a number of cases where ball bearings are used on various machine tools, the examples being taken from both American and European practice.

One of the oldest uses for ball bearings in machine tools is on the vertical spindles of drill presses. Ball bearings used in this manner have proved successful when proper bearings, properly mounted, have been used. The Colburn Machine Tool Co. showed at the recent convention of master mechanics and master car builders at Atlantic City a heavy drill press driving a 1½-inch drill through 31 inches of cast iron per minute, and a 3½-inch drill through 11¼ inches per minute. It is evident that here a heavy thrust is produced. This thrust is taken by a Hess-Bright ball bearing of the self-adjusting seat type. On radial drill columns, the weight is sometimes taken on a thrust bearing at the top. It is preferable to take the weight at the top on a ball bearing placed there, rather than on a ball bearing placed at the lower end of the column. The reason for this is that the relatively small bearing at the top costs only a small fraction of what a ball bearing big enough to surround the column at the bottom would cost. In order to relieve the friction due to the pressure that the sleeve exerts at the base of the column in a radial direction, this pressure is taken on one or more small radial bearings, arranged in a special manner. These small bearings cost much less than a single large one, and are quite as efficient. In the swinging arm type of radial drills, bearings are employed at the top and bottom to take the radial thrust and a compensating seat thrust bearing is placed at the bottom to take the vertical load.

Certain German milling machines take the thrust of the table-elevating screw on a ball bearing. The Becker Milling Machine Co. shows in its catalogue some types of belted vertical milling machines with speed boxes equipped with Hess-Bright ball bearings. Other prominent American builders of this line of machines take the feed screw thrust on ball bearings. One German type of heavy worm-driven 144-inch planer is provided with two thrust bearings for taking the worm thrust both on the forward and reverse strokes. It has been found that the correct employment of suitable ball bearings on a planer eliminates all liability to back-lash, and increases the ease of running the planer as well as its power efficiency.

The weight of the vertical spindle of a surface grinder built by the Blanchard Machine Co. is taken at the top on a ball thrust bearing, and the radial load at this point is taken on a radial ball bearing, while the grinding thrust is taken immediately above the face grinding wheel on a ball thrust bearing. The entire countershaft of a grinding machine, built by Unger of Stuttgart, Germany, is mounted on ball bearings. The author stated that in the Hess-Bright Co.'s own shops they had also remounted on ball bearings a number of their grinding machine countershafts as well as the wheel spindles. It was found that while the belts were frequently thrown off in suddenly starting the machine, when the machine was provided with the original plain bearings, the substitution of ball bearings entirely eliminated this difficulty. In addition, the annoyances due to wear and the necessity for frequent lubrication have been done away with. The Pratt & Whitney Co. uses ball bearings on a very heavy grinding machine, the entire load of 10- and 7-inch belts being taken on ball bearings. The Rushmore Dynamo Works has mounted a con-

*Abstract of paper by Henry Hess read before the National Machine Tool Builders' Association Convention in New York, October 26, 1910.

siderable number of its grinding and buffing heads on ball bearings after having first thoroughly tried them for durability and other qualities.

In the examples mentioned so far, ball bearings have been employed under fairly uniform conditions as to load, and at speeds ranging from moderate ones on drill presses, milling machines, etc., to high speeds on grinding machines. Ball bearings, however, are used with very decided success under conditions where they are subjected to considerable shock, as for example, in heavy punch presses in which the driving shaft is mounted on a ball bearing. This is done on fairly heavy presses, having driving gears weighing 2000 pounds. Carefully made comparative tests on this press showed that the ball bearings decreased the power used on the idle stroke by 54 per cent. The power used with a plain bearing during the working stroke was 16.8 horsepower, which was reduced to 13 horsepower with the ball bearing. The power saving for the complete cycle was about 40 per cent. A punch press provided with these bearings has been in use for a number of years and the ball bearings do not yet show the slightest indication of wear.

Ball bearings can be used to advantage on cold disk saws. In a special case the plain bearing required renewal about once every three weeks, and that renewal necessitated a returning of the shaft itself, and hence put the machine out of commission for some time. The disk ran at a speed of 4100 revolutions per minute and required 20 horsepower. It would, when thrown in, almost stall the motor, and it frequently blew out the fuse. A stream of cold water was kept constantly running through the water jackets of the babbitted bearings. The same machine provided with Hess-Bright ball bearings and driven by a 7½ horsepower motor has ample power, and readily takes up the load without shock. The machine has now been running for over a year and no deterioration in the bearings has been noticed.

The use of ball bearings on wood-working machinery is of no less importance. One of the largest European manufacturers of this class of machinery, Fleck & Sohne, of Berlin, Germany, use ball bearings to a very great extent in their machinery. This firm considers the matter of ball bearings of such vital importance that its catalogue reads very much like that of a ball bearing manufacturer. Carefully conducted tests have shown that the power saving amounts to 60 per cent when the machines run idle, and while in action the actual horsepower saved is still greater, owing to the greater load on the bearings. This company also states that besides the saving of power, the wear is very much reduced, all danger of heated bearings is eliminated, and the consumption of lubricant is greatly reduced. Among American woodworking machine builders, the Defiance Machine Co. mounts an 18-inch spoke lathe on ball bearings. With the original babbitted bearings, two horsepower was required to run the cutter-head idle and 7 horsepower for turning an 18-inch spoke. When mounted on ball bearings these values were reduced to 0.8 horsepower and 5.8 horsepower, respectively.

A somewhat peculiar condition of affairs relating to the introduction of ball bearings, is that many of those who employ them ask in the first place for an exclusive right to use them on their machines as against their competitors, and then, as that is not possible, that no mention be made of the use of ball bearings for their certain class of machines, in order that their competitors may be kept in the dark as long as possible. This condition, of course, is irksome to the manufacturer of ball bearings, since it prevents the using of the most effective of all arguments in convincing a prospective customer.

Ball bearings can also be used to considerable advantage on the countershafts for machine tools. In the German Niles Tool Works the entire line of countershafts is thus mounted. In German practice ball bearings are used on cranes, both in the trolley and for the hook. In one case a swing crane column is mounted on ball bearings carrying up to 10 tons horizontally and 14½ tons vertically. Radial ball bearings are regularly made in sizes with carrying capacities up to 14,000 pounds, and thrust ball bearings for loads up to 28,600 pounds at 10 revolutions per minute. Special ball bearings can be made to suit any demand, even up to a load of 400,000 pounds.

CONCRETE VS. WOOD FLOORING

The subject of "Concrete vs. Wood Flooring for Machine Shops" was of great interest to us because we had just prepared plans for a new shop which would more than double the capacity of our works, these plans calling for reinforced concrete construction with saw-tooth roof, etc., and the question of the best floor had, of course, been one that called for considerable study.

Letters were sent out in which two questions were asked: 1. Are you using concrete floors at present, and are they satisfactory to you and the workmen? 2. If you were to build a new shop, what would your experience lead you to use for the floors, and how would they be constructed?

In answer to these inquiries forty letters were received, of which eight were distinctly in favor of concrete floors for machine shop use. There were twenty-six decidedly in favor of wood, and six were non-committal, being favorable to either under certain conditions and for certain work.

These reports came with only one or two exceptions from those operating machine shops, although sixteen of them were not machine tool builders. All of the eight who preferred concrete have had experience with both wood floors and concrete floors. Seventeen of the twenty-six preferring wood floors have actually had experience with both; the other nine based their preference for wood upon investigations made by them when looking up this matter for their own benefit. The general point of view of the writers of these letters can best be given, perhaps, by two or three extracts from the letters received, the first being from Southern Vermont.

"Regarding concrete floors for shops, we built a three-story cement and steel building in 1904, and in 1907 we put up a saw-tooth single story building. In both of these buildings we have used concrete floors without wood. We noticed the men who were accustomed to standing on a wood floor became more 'foot-tired,' at least at first, in the cement building, and possibly those whose work gave them an opportunity to move about were also slightly affected in the same way, but as for this we are not sure. . . . In these buildings with concrete floors we provide a thin platform of wood for men who do not move about; we do not find it necessary to provide it for others. The planer and the bench hands whose work calls for standing in one position most of the time need the wood insulation.

"At first we thought it was the difference in the hardness of the material, and in fact, this may be one of the reasons why it is more tiresome, but the Aberthaw Construction Co. put out a circular on this subject, in which it was suggested or stated that the reason cement floor was objectionable was that it carried off the heat from the men's feet faster than the wood, which is not as much of a conductor of heat, and that, with the same temperature, this greater heat conductor produces the undesirable effects, and in that paper we think it used the comparison of the difference in feeling in the hand of an iron and wood surface of the same temperature. Among other objections was that the cement was supposed to increase rheumatic troubles. We have had no such complaints, and have felt that the advantages more than off-set the disadvantages.

"It makes a cleaner, more wholesome shop—one in which it is possible to clean the floors from all of the objectionable matter that accumulates in the cracks of wood floors, and it also makes possible the introduction of cuspidors cast directly in the floor, into which we run a flushing stream at regular intervals.

"If plants could be heated through simply warming the floor, as we believe has been suggested, then the only serious objection to the cement floor would be removed. It is possible that the hollow tile may serve for this purpose. I refer to the hollow tile made by the National Fire Proofing Co. A layer of this tile with openings registering the entire width of the building, and connected with conduit pipes on the lines already suggested, would give a very even distribution of heat and would not make an expensive floor, although the total thickness would have to be probably 2 inches under and 2 inches over of cement, with hollow tile of 4 inches or 6 inches, according to the load.

"This would bring the temperature of the floor up closer to that of the workmen's feet, and would make the floor the warmest part of the building, and do away with pipes of all kinds. It might not be necessary to have any immediate openings into the room, excepting for a slight circulation. There is no reason why steam pipes could not be put in the same openings.

"There remains the element that always enters into the use

* Abstract of paper by James N. Heald, read before the National Association of Machine Tool Builders' Convention, at New York, October 26, 1910.

of concrete which must be seriously considered by anyone building a more than one-story building. A few shovels of earth without the proper amount of cement, or a few shovels full of inferior earth material instead of sharp sand, may happen to be placed where it will cause serious disaster, but we have had no experience of this kind, excepting that we have had to worry about it, particularly at first."

Among the letters favoring wood floors, the following from Cleveland, Ohio, will be of interest:

"We have one building in our group made all out of concrete. This building is three stories high and all the floors are concrete. We have been greatly disappointed in the concrete floors. In the first place any water spilled on one of the floors filters down through to the next. These floors are not suitable for trucking, as they chip out and wear in grooves. Our men do not like them and complain of the effect that standing on the concrete floors has upon their legs. This may be imaginary, but it is to be considered.

"We have recently made an experiment on these floors by covering them with about two inches of first-class paving asphaltum put on by the company that does the asphaltum paving in this city. So far, we think this is an improvement, and another year may extend this coating over all the floors in this building.

"In our judgment the best floor for a factory is narrow matched maple. It wears smoothly and is easily repaired."

The second is from a manufacturer of automobile parts in Detroit, Mich.:

"We are using concrete floors in our factory building, which is devoted to light machine shop manufacturing operations. From our experience so far, we are quite firmly of the opinion that this is a decided mistake, and that wood floors would be much better and more economical in the long run for this kind of work. While there have been a few cases of complaint from workmen, this has not been at all serious. So our objection to concrete is more on the score of its being unsuitable as a wearing and working surface in general as applied to machine shop operations. As a matter of wear, we find it giving way much more rapidly than we had anticipated, while due to this and at the same time aggravated by the presence of metal chips and oil, it is rather difficult to keep clean. Another serious objection to concrete is the invariable damage suffered by tools and finished pieces of work dropped upon it.

"One-inch to one-and-one-half inch by three-inch maple is generally considered to be the best flooring material, and is what we should use in future."

The third and last is from a manufacturer in Stamford, Conn.:

"We have in two instances in our factory examples of concrete floors on which active manufacturing is being conducted, and in both cases, during the winter months, we have trouble in keeping the men comfortable in these rooms. The reason undoubtedly is due to the fact that the concrete floors abstract the heat of the body from the feet, chilling the blood and consequently producing a feeling of discomfort which is attributed by the employes to want of proper heat in the room.

"The main portion of our factory is composed of wooden floor of three thicknesses, namely a supporting floor of sufficient strength underneath, an intermediate floor and a top wearing floor of maple. We find that this construction of flooring gives us excellent satisfaction from the standpoint of the employes and likewise has the advantage of being readily repaired by replacing the upper surface without disturbing the main features of the construction of the building.

"In two of the buildings we have used the reinforced concrete form of construction as far as the floors and columns are concerned, and in this instance we have put screeds in the concrete, nailing down an intermediate floor and top wearing floor of hard maple as above. This method has given excellent satisfaction, and the writer has had the chance of studying, from his own personal feelings, the effects of such a floor, on account of our main offices being laid in one of these reinforced concrete buildings.

"On the ground floor we have used a method of tar concrete for a depth of four inches in which are buried screeds, and an intermediate floor and top maple floor as in the above examples cited. This method for the ground floor work is highly satisfactory, as it keeps out the dampness and preserves the floor. The writer had the experience within the past six months of taking up a portion of a floor of this character, which had been down thirty years. The under flooring and screeds were just as clean and well preserved as if they had just come from the lumber yard.

"In cases where we have found sensitive persons complaining as to the conditions arising from the use of concrete floors, we have made a lattice of wood for the employe to stand upon with a marked improvement in his physical comfort."

During the last three or four years the use of concrete for factory buildings has greatly increased, and when properly reinforced, has proved entirely satisfactory, and owing to the reductions in the cost of cement and increases in the cost of other materials, the use of reinforced concrete has become quite general, and therefore floors of such structures are worthy of special notice. Reinforced concrete floors are made in numerous styles by different engineers, but the fundamental idea is that of using bars or other forms of steel as the tension members, imbedded in concrete bodies. The floor proper is simply a slab like a cement sidewalk with reinforcement near the lower surface and supported by beams of concrete, also reinforced, which are formed as a part of the slab.

The Effect of Granolithic Floors on Operatives

It is claimed by some of the advocates of concrete floors, that the real cause of the workman's complaint is undoubtedly the coldness and not the hardness of concrete floors. Everyone knows that the coolest seat on a hot day is a stone doorstep, and like the stone step, the concrete floor feels colder than the wood floor. When a concrete floor is in contact with the ground, it actively withdraws heat from its inner surface because it is a good heat conductor. At all seasons the concrete floor feels colder than the wood floor and the effect of this on the operator who stands for hours in one place is to gradually chill his legs and thus retard the circulation in them. In some shops the operators not only bring in boards and the like to stand on, but have gone so far as to wear heavy overshoes during working hours.

The actual heating of the concrete floor-slab itself by means of contained steam pipes or hot air ducts arranged in the substance of the flooring has proved remarkably successful in the plant of the Morse Chain Co., Ithaca, N. Y.

In this plant, which was described in the *American Machinist*, February 10, 1910, the workrooms are heated by radiation from the concrete floors, with no direct admission of hot air except in extremely severe weather. The experience of the Morse Chain Co. seems to demonstrate that workmen have mistakenly attributed the effects of the cement floor to its "hardness," when in fact it was the "coldness" which was to blame.

Taking up now the requirements of satisfactory floors of concrete, we come first to the wearing qualities:

1. Liability of granolithic to wear into hollows, or ruts, under heavy trucking.

2. Dust, due to abrasion of the floor surface, which is sometimes merely disagreeable, but which in other cases works damage to machinery and product.

3. The difficulty of making effective repairs in granolithic finish.

4. Trouble in attaching machines to granolithic floors.

Trucking, as shown by the letters received, develops considerable trouble, especially where the concrete blocks are marked off into squares, as is usually done. It would be much better, so far as this point is concerned, if the marking off of the squares (which is done partly for looks and partly that any cracks which develop may run through these markings and in that way not show in the level surface) was omitted in such floors.

One suggestion has been made by an advocate of cement floors, which is that flat iron bars slightly separated and not on edge be imbedded in the floor in the direction in which the trucking is done, and in that way take the wear of the trucks and save the concrete. These are better than solid flat plates which become polished and therefore very slippery after a time.

Various paints are offered to prevent dust, but they are of very little value; the floors can be kept painted, but the expense seems prohibitive. No film, as thin as the average coat of paint, will permanently resist the usual wear of the shop. It is claimed that a boiled linseed oil thinned with gasoline or naphtha until it runs into the pores of a porous surface, oftentimes prevents trouble and is cheaper than some of the floor paints. This preparation is incidentally a good waterproofing for porous surfaces, as well as a preventative of dust.

In the matter of repairs, the granolithic surface is obviously at a disadvantage compared with wood, because of the difficulty of firmly bonding new material to the old.

The difficulty of attaching machines to the concrete floor is probably over-rated by those who have had no experience in this line. Many of the later types of machine tools are so heavy, so well-designed and so nearly self-contained that they require very little, if any, attaching or bolting to the floor, and, therefore, the drilling for plugs into which screws can be driven, or the use of expansion bolts, should be a comparatively simple matter.

The breakage of parts in process, by dropping, is something that must be considered individually. If manufactured articles are delicate and finished all over, there is risk of serious injury to them in dropping on a concrete floor, which would not be the case with a wood floor. Therefore, if the article being made is fragile the wood floor is quite desirable.

With regard to cleanliness, there is not much question but what the concrete floor can be kept cleaner than the wood floor, which has so many cracks, usually full of dirt. What dirt accumulates on the concrete floor is right on the surface and can much more readily be taken up.

With reference to waterproof granolithic floors, experts say that they must be troweled hard in order to make the surface durable, and that this troweling also makes it practically waterproof. There will be no leakage of water that may get into the surface, except at joints, and possibly in places that have been worn by use. The extent of damage would be simply whatever was done by the leaking water in the room below. The conclusions are, that the highest success in the construction of a granolithic floor surface can be obtained only by following very carefully correct principles of construction and certain methods of manipulation, in order that the surface may be able to give the service expected of it.

There are certain situations where in spite of its higher cost, the wood top floor is probably better than any granolithic surface for the owner to put in, simply because his case may require certain qualities which the wood top can provide, and which no masonry surface can give, and which he must have, even at a higher first cost.

The virtues of a wood floor are inherent in naturally formed material whose fitness is apparent at a glance. Saw up the tree, season the sawed and planed strips, let the carpenter make them into a floor, and you have a wearing surface of certain high recognized value. With the granolithic surface in contract, it is necessary to select cement and other materials for certain qualities which are not evident in the appearance of these materials; correct proportions must be determined; materials must be put on the right kind of surface and at the right time, and must be manipulated in the right manner. The green surface must be protected for a certain number of days while it is setting. The mere statements of the procedure necessary with the granolithic finish is enough to show that the average granolithic floor will be more or less unsatisfactory, because the average concrete workman is inclined to hurry, and is often poorly informed as to the procedure necessary for getting a good surface, and for that reason to a large extent, the success or failure of a granolithic surface comes down to the question of workmanship.

The cost of different types of flooring varies considerably in different localities according to the relative prices of the materials at that point. In a general way it might be said that the finished granolithic floor would cost around 25 to 30 cents per square foot, and a concrete floor with wood top covering, as suggested above, would figure 12 to 14 cents additional.

* * *

The White Star triple-screw steamer *Olympic* was launched at the Harland & Wolff shipyards, Belfast, Ireland, October 20. The new vessel is 882 feet long, 92 feet wide and displaces 66,000 tons; it is 92 feet longer than the *Lusitania* and the *Mauretania* of the Cunard line, and displaces 21,000 tons more, but will be a slower boat than the Cunarders, its speed being 22 knots. The rudder weighs 100 tons, and will be operated by electric motors. The rivets used in the hull weigh 1200 tons and number 3,000,000. The *Olympic* and its sister ship the *Titanic*, now building, will accommodate 2500 passengers and carry crews of 860.

ANNUAL CONVENTION OF THE NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION

The ninth annual convention of the National Machine Tool Builders' Association was held in New York October 25 and 26 at the Hotel Astor. The association has grown from the small group of twenty-eight manufacturers of lathes, drilling machines, planers and milling machines who met at the Hollenden, Cleveland, in October, 1902, to perfect an organization, to a body embracing a large part of the machine tool industry in the United States, the membership now numbering one hundred and forty-five concerns building all classes of machine tools.

The present administration has done extraordinary work in increasing the membership, and President F. A. Geier and Secretary C. E. Hildreth are entitled to much credit for their work in cooperation with others, in strengthening the association. The following new members have been admitted since the Rochester meeting in May:

Acme Machine Tool Co	Cincinnati, Ohio.
Bardons & Oliver	Cleveland, Ohio.
Blanchard Machine Co	Cambridge, Mass.
Cincinnati Pulley Machinery Co	Cincinnati, Ohio.
Blount, J. G., Co	Everett, Mass.
Cleveland Automatic Machine Co	Cleveland, Ohio.
Cleveland Planer Works	Cleveland, Ohio.
Fay Machine Tool Co	Philadelphia, Pa.
Frontier Iron Works	Buffalo, N. Y.
Gardner Machine Co	Beloit, Wis.
Gleason Works	Rochester, N. Y.
Grant & Wood Mfg. Co	St. Louis, Mo.
Knight, W. B., Machinery Co	St. Louis, Mo.
Lapointe Machine Tool Co	Hudson, Mass.
Lea Equipment Co	New York.
Lees-Bradner Co	Cleveland, Ohio.
Milwaukee Machine Tool Co	Milwaukee, Wis.
Morse Twist Drill & Machine Co	New Bedford, Mass.
National Machine Co	Hartford, Conn.
Newton Machine Tool Works, Inc	Philadelphia, Pa.
Putnam Machine Co	Fitchburg, Mass.
Ransom Mfg. Co	Oshkosh, Wis.
Robbins Machine Co	Worcester, Mass.
Sloan & Chace Mfg. Co	Newark, N. J.
Wood Turret Machine Co	Brazil, Ind.
Willard Machine & Tool Co	Cincinnati, Ohio.
Wilmarth & Morman Co	Grand Rapids, Mich.

The meeting opened with the usual routine business, following which were the reports of the following committees:

Patent Committee, C. L. Taylor, chairman; Committee on Revision of Constitution, A. H. Tuechter, chairman; Apprenticeship Committee, E. P. Bullard, Jr., chairman; Cancellation of Orders, also Dealers' Commissions Committee, C. Wood Walter, chairman.

Ways and means of checking the evil of cancellation of orders at the pleasure of the buyer were threshed over with a vigor that showed what a vital subject it is to the members of the organization, and to the trade in general. While it was conceded that there is no practicable way of enforcing the acceptance of all orders contracted for, it was believed by some of those who have given the matter much thought that the practice of cancellation without good and sufficient reason could be made so disreputable that it would cease to be the disturbing element threatening the prosperity of the trade. It is a well-known trick winked at because a "trade custom" for the purchasing agents of large corporations to order machine tools of all kinds recklessly, for delivery several months in the future on the chance that they will be badly needed to take care of anticipated business. If that business does not materialize, the orders are cancelled without compunction, and the machine tool builder must shoulder the load. A resolution was passed to the effect that no cancellation of orders would be accepted, provided shipment is made within the time specified. The National Supply and Machinery Dealers' Association, through its committee, has signified that it will cooperate in checking the practice. A step forward has been taken in creating a moral sentiment against an abuse that is not tolerated in any other manufacturing industry.

The dealers have signified their desire for increased commissions on rates to compensate for the increased cost of selling. The report of the committee appointed to investigate was

to the effect that the commission to which a dealer was entitled was a variable matter, depending largely on the prestige of the concerns represented and their selling policies. No general scale of commissions could be agreed on by the members of the association, as the commissions must necessarily be adjusted to suit individual conditions.

In his report on apprenticeship conditions, Mr. Bullard spoke of the great importance of the uniform apprenticeship agreement adopted some years ago by the association. This statement brought out discussion of the fact that the "master and servant" laws of the states do not agree, and it is virtually impossible to draw a contract binding an apprentice and employer that will be legal in all the states.

The revision of the constitution, a draft of which was read by Mr. Tuechter, will be voted on by letter ballot after the members have had an opportunity of criticising it by letter.

Two interesting papers on the subject of who should pay the expenses of a representative sent from the works to assist an agent, were presented by Messrs. F. L. Eberhardt and C. H. Norton. Mr. Eberhardt stated that it had been found advisable, in most cases, to send a man from the works to set up the machine, and have the selling price cover his expenses. On the contrary, Mr. C. H. Norton was of the opinion that a man, employed by the manufacturer especially for this work, who thoroughly understood the construction of the machine, should accompany it, set it up and demonstrate how to operate it. His expenses were to be covered entirely by the manufacturer, unless other arrangements had been made with the agent. Both came to the conclusion, however, that to obtain satisfactory results to all concerned, it was absolutely necessary for the manufacturer, agent and his salesman to work in cooperation.

Mr. Henry Hess of the Hess-Bright Mfg. Co. read the interesting paper "The Use of Ball or Roller Bearings in Machine Tool Construction." An abstract appears elsewhere in this number.

Mr. Thomas H. Moore, advertising manager, John Wanamaker, New York, spoke on the subject "Advertising—Large Space in a Few Papers vs. Small Space in a Number of Papers." Mr. Moore conceded that he knew so little of the practical conditions of the machine trade that he was unable to advise which is the best policy for the machine tool builders. In a large retail business, all kinds of advertising are legitimate, as it is the aim of the retailer to reach all classes of buyers. In the retail business 2 to 3 per cent of the total sales is a conservative appropriation for advertising expenses.

The growing importance of concrete in machine shop construction made the paper "Concrete vs. Wood Flooring," by Mr. James N. Heald of the Heald Machine Co., of great interest to the members of the association. An abstract of the paper will be found in this number.

Messrs. C. K. Lassiter, mechanical superintendent of the American Locomotive Works, and John Riddell, of the General Electric Co., read papers on: "The Design and Construction of Machine Tools from the User's Standpoint." An abstract of Mr. Riddell's paper is presented in this number.

The meeting was one of the most successful in point of attendance and interest displayed. Every session was attended by a large majority of those registered, and the good work of the officers and contributors of papers was highly appreciated.

The following officers were elected for the coming year, President Geier and Secretary Hildreth being re-elected: President, F. A. Geier, of the Cincinnati Milling Machine Co.; First Vice-President, Charles H. Alvord, of the Hendey Machine Co.; Second Vice-President, S. H. Reck, of the Rockford Drilling Machine Co.; Treasurer, A. E. Newton, of the Prentice Bros. Co.; Secretary, Charles E. Hildreth, of the Whitcomb-Blaisdell Machine Tool Co.

The next semi-annual or Spring meeting will be held in Atlantic City, N. J.

The report would be incomplete without mention of the very enjoyable theatre party of machine tool builders, friends and ladies entertained Thursday evening by the *American Machinist* at the New Amsterdam, where the popular musical comedy "Madame Sherry" is playing.

DESIGN AND CONSTRUCTION OF MACHINE TOOLS FROM THE USER'S STANDPOINT*

The author of the paper abstracted in the following dealt with the subject with particular reference to the practice followed in the Schenectady Works of the General Electric Co. He has been considering seriously the advisability of having, instead of standard engine lathes, simple turning machines, to produce pieces, such as small shafts, which are required in quantities; but since there is a certain variation as to dimensions in this class of work, the machines should not be so special that they could not be used for a general run of similar work. It has been the practice to purchase standard engine lathes fully equipped for screw cutting, and with cross-feed, rod-feed, compound rest, large and small faceplates, and frequently, with an extra block for large outside turning. It was thought advisable to have the machines as universal as possible. Experience has taught, however, that an engine lathe once placed in, say, the shafting department, would often wear itself out before having to do any faceplate, chucking, or screw-cutting work. Hence, lathes for shafting should be equipped with a powerful rod-feed, and with a suitable friction device which would slip if the turning tool should meet with any obstruction. They should also be so designed that the screw-cutting attachment and cross-feed could be readily applied, if required later.

Numerous attempts have been made to solve the problem of small shaft turning, but many machines designed for this purpose have been rather complicated, which precludes the use of inexperienced men to run them. A lathe to be used exclusively for shaft turning, say from about 2 to 4 inches in diameter, would not require the range of speeds of a standard engine lathe. All the range of speed required would be from about 20 to 250 revolutions per minute for turning, and two or three higher speeds for filing and polishing. These speeds should possibly be between 450 and 600 revolutions per minute. It is desirable to have such machines fitted for electric motors. The motors should have a speed variation of about two to one, which, with two or three gear changes, would give all the speeds necessary.

The automatic screw machine, in a general way, is made so that six, seven, or eight operations can be performed. A very large quantity of the work, however, requires but two or three operations, such as milling, threading, and cutting off. Many screw machines are so complicated that they perform the operations whether the tools are actually working or not. It would seem that machines could be very much simplified by making some do three or four operations only, and not encumbering them with too many useless parts.

The same is true of some larger automatic turret lathes. Some of these machines are designed for boring and facing, but nevertheless the turret has five or six positions, all of which require certain movements even when there are but one or two simple operations to be performed.

Machines such as shapers and slotters appear to be as simple in construction and design as they should be made, and they have all the necessary feeds and speed variation.

It is gratifying to see that some machine tool builders are making variable speed planers. This would seem quite necessary at present, on account of the variety of material which planers are called upon to machine. We have a range of material from chrome-, nickel- and vanadium-steels, to the various steel castings, and from cast iron to aluminum. It is, therefore, necessary that planers can operate at a satisfactory speed on any kind of material. This can be accomplished by variable speed motors, or through gear change boxes.

In regard to milling machines generally, there is a pretty large range to select from, and there are several satisfactory types and makes. Drill presses have been well taken care of also. Sensitive drills can be purchased with any number of spindles, and with one or two changes of speed. A full line of upright machines can be purchased with or without tapping attachment; the tapping attachment has become a necessity

* Abstract of paper by John Riddell read before the National Association of Machine Tool Builders' Convention, at New York, October 26, 1910.

in a great many cases. Complaints are heard about the breaking of taps by its use, but with tap holders which can be adjusted to slip before breaking, this fault can be overcome. A great deal might be done toward adapting multiple spindle heads to single spindle presses. It is doubtful if, as at present constructed, it is good judgment to put in too many expensive multiple spindle drills, for the reason that it takes too long to adjust them for a small number of pieces.

Radial drills generally should be so stiffened as to allow of only the smallest amount of spring to the arm. Many drills are ruined by the springing of the arms, because under the pressure of drilling, the arm goes up, and when the pressure is relieved from the point, the drills are forced through, and, in many cases, catch on the lips and break.

Grinding machines, generally, are probably as near perfection as can be expected, and there seems to be very little to be desired from the user's standpoint. There is one very important point, however, about all grinders, and that is the protection from injury to the operator by the breaking of wheels, and from dust. There should be exhaust hoods of ample capacity provided with each dry grinder, as well as some safety device to prevent the wheel from flying in case it should break.

Horizontal boring mills are well up to the times, but in many cases, as for gasoline engine cylinders and work of similar character, special machines should be provided, as this work is very particular, and in many cases presents special difficulties. Vertical boring mills are built for various purposes, from car wheel borers up to machines taking 25 feet or more. It does not pay to unnecessarily complicate such machines; rigidity and accuracy are the essential points, and these features should not give way to unnecessary complications. All gears and counterweights should be thoroughly protected against injury to the operators.

From an experience extending over some twenty-eight years in the electric motor business, the author said that he was a thorough believer in the individual electric motor drive. Criticism has been made on the ground that on universal machines which might be called upon to do from a fraction of a horsepower of actual work, to six or seven horsepower, the investment is unnecessarily high as compared to group driving. To a certain extent this is true, but if more care were exercised in designing along the lines just indicated, this criticism would disappear. As to advantages, a motor-driven machine can be taken from any part of a large plant and placed in another part, and can be running in a very short time in any location where there is no other source of power. It will only absorb the amount of power actually required to do any particular job, and the line shafting with its hangers, pulleys, etc., is eliminated.

Considerable difficulty has been experienced at the Schenectady Works trying to conform to the new State laws, which are very stringent as to the protective devices on machine tools in general, and on wood-working machines in particular. It is an exceedingly difficult matter to so protect buzz-planers and circular saws as to guard against carelessness and the apparent indifference of the workmen, and there is a need for proper means for protecting such machines. Accidents are frequently due to carelessness on the part of the operators, often because they will not take time to shut down their machines when making adjustments, for the reason that a spindle running at 3000 or 4000 revolutions per minute would require an appreciable length of time to come to rest, and also to start again. This would suggest some suitable brake which would quickly and effectively stop such machines.

If an operator has a great many pieces of a similar kind to either saw, plane or shape, he may possibly take pains to apply such guards as are usually provided, but if a man wants to work on one single piece he will not take time to adjust the safety appliance; hence the necessity of suitable guards which would always be available no matter what the conditions might be. As it is, the market is flooded with unsatisfactory devices, which are mere traps and, generally, do more harm than good.

Punch presses in general are very well designed, but they, like wood working machinery, are dangerous. In the Schenectady Works there are several hundred of these machines, and many safety appliances for protecting the workmen have been applied, but it appears that these devices are either taken off or neglected in some manner, so that sooner or later an operator is hurt. This suggests effective automatic feed mechanisms, and something to take the piece from the dies after the operation is completed. Another defect in this class of machinery is that when clutches and other parts come loose, due to wear, the press is very apt to repeat the stroke. This frequently happens when a man's hand is between the dies. Such accidents should be made impossible.

There is a great deal of gear noise in the machine shops of the present day; this is not wholly due to the fact that there are more gears used in the construction of machine tools, but is more especially due to the higher speeds at which the machines are run. Shafts are turned at a cutting speed of from 75 to 125 feet per minute instead of at 20 feet which was formerly a fair speed. Hence, the machines of to-day are producing from three to six times more work than they did a few years ago, and it should follow that there would be more noise. These gear noises are very unfortunate but with improved gear cutting machinery and the use of various materials which have recently been introduced, this trouble will gradually disappear.

The Schenectady Works have introduced gears made of a high grade of muslin. One of these has been used for two years on a boiler maker's punch and shear which previously gave considerable trouble, both on account of noise, and from the breaking of the gears, due to excessive back lash and flywheel action. The success with the muslin pinion was so pronounced that the use of these gears was gradually extended until they are now used on two 10-foot planers operated by electric motors and compressed air clutches, as intermediate pinions for the reverse motion. Various other substitutes experimented with, including bronze, would go to pieces in two or three weeks; steel would last longer, but made an intolerable noise; and rawhide would seem to shrink and burn out quickly. The muslin pinions have at present been running four months and they have not yet begun to show any signs of distress.

In order to test muslin pinions to destruction two railway motors opposed to each other were rigged up. One of them had a cloth pinion on the armature shaft running into a steel gear on the countershaft. On the other end of the countershaft was another cloth pinion engaging with another large steel gear. The other side of this steel gear engaged a cast gun-iron pinion of the same dimensions as the cloth gear. This was connected with its shaft and gear to a rawhide pinion on the opposite motor. That particular motor was resisted by rheostats to load the motor which had the muslin pinion. In starting this test there were no results from a normal load. An excessive overload was applied, however, and the shock was so severe that it broke about one-half of the teeth from the gun-iron pinion, leaving the two muslin pinions in as good a condition as before. Another gun-iron pinion was put on, which also broke. A third was then put on and the load reduced, and the life test has now been running some two or three weeks, and will be continued until some of the gears actually wear out, as they cannot be broken. Hence we have reason to believe that with the use of this new material, the noises in machine shops will gradually disappear.

There is one other thing that must be borne in mind in the production of machine tools, and that is the gradual disappearance of the old time all-around mechanic. It has frequently been pointed out, when some special machine tool has been brought out to reduce the cost of certain operations, that such a machine could be operated by a farmer boy, or one without any practical knowledge of machine tools. This has very seldom proved to be the case as such a one cannot make the necessary adjustments on such machines. Therefore, simplicity is a prime factor in machine tool designing; and to sum up briefly, the essential requirements, besides simplicity, are rigidity and accuracy, with ample protection for the workmen.

MACHINERY'S EIGHTH ANNUAL OUTING

The National Machine Tool Builders' Association Convention was followed by MACHINERY's eighth annual outing, October 27, at Sea Cliff, Long Island, where over five hundred and fifty men—and Miss Kate Gleason—prominently connected with the industry were entertained for the day. The steel

Hot Potato Race

steamer *Majestic*, having a much larger capacity than the *Sagamore* used several years heretofore for these outings, was chartered for the day to transport the party through the winding East River to the destination on Long Island Sound.

A Leg and a Half apiece

The day was perfect for the event and a most enjoyable time was spent "refreshing the inner man" and watching the athletic sports. These consisted of a potato race, three-legged

The "Rube"

race, relay race, football (soccer) and push ball. Following are the names of contestants and winners:

Potato Race

C. H. Pierson, 1st; B. F. Damon, 2d; S. H. Simon, 3d; J. T. Ryerson; A. F. Corbin; A. I. Jacobs; W. B. Johnson; G. L. Markland, Jr.; H. W. Mons; W. H. Miller; C. F. Tucker; E. Rivett, judge.

Three-legged Race

N. E. Zusi and H. A. Pratt, 1st; O. P. Meckel and A. A. Mills, 2d; E. Stillman and A. G. Lea, 3d; G. J. Thompson and A. E. Hoermann; O. R. Adams and J. T. Ryerson; E. W. McKeen and Geo. Rowbottom; E. J. Frost and Geo. B. Woodruff; C. J. Wetsel, judge.

Relay Race

Massachusetts, 1st.—A. R. Stedfast, captain; O. R. Adams; J. O. Smith; C. J. Wetsel.

New Hampshire and Vermont, 2d.—O. M. Flather, captain; W. L. Bryant; R. E. Flanders; H. E. Flather.

New York, 3d.—H. A. Pratt, captain; A. G. Lea; E. Stillman; A. I. Totten.

Illinois.—J. T. Ryerson, captain; E. T. Hendee; H. W. Mons; S. H. Reck.

Ohio.—H. M. Lucas, captain; H. V. Hilker; H. M. Hitchcock; J. G. Oliver.

Football (soccer)

East—Forwards: A. E. Carpenter, P. M. Brotherhood, W. C. Buell, Jr., W. L. Neilson, H. H. Pease. Halfbacks: H. L.

Push Ball—Up against it

Sevin; A. R. Stedfast, S. A. Howell. Fullbacks: W. F. Loomis, C. W. Higgins. Goaler: D. M. Wright, captain.

West—Forwards: C. R. Burt, E. L. Essley, O. B. Iles, W. H. Reid, H. A. Seaverson. Halfbacks: C. Wood Walter, E. T. Hendee, A. J. Larmon. Fullbacks: A. T. Barnes, H. W.

Star Players

Trout. Goaler: C. A. Johnson. W. Ingersoll, captain.

East, 9 points; West, 6 points.

Push Ball

East—A. E. Newton, captain; L. M. Batting; E. Blake, Jr.; G. Briggs, Jr.; R. L. Crane; H. E. Erwin; H. E. Flather; S. E. Horton; R. B. Jacobs; J. N. Lapointe; W. P. Poole.

West—E. F. Muther, captain; H. T. Bradner; J. E. Brandt; C. T. Bush; D. J. Campbell; A. C. Cook; H. M. Hitchcock; E. J. Kearney; A. J. Larmon; O. P. Meckel; W. R. Mitchell.

W. A. Viall, referee; C. S. Stallman, assistant referee; G. E. Merryweather, scorekeeper; J. H. Drury, timekeeper; H. C. Woglom and W. H. Miller, linemen.

The East won by 8 yards.

The stein for the most popular machine tool builder was voted to Miss Kate Gleason, of the Gleason Works, Rochester, N. Y.

PERSONALS

E. R. Evinger, formerly of the National Automatic Tool Co., Richmond, Ind., has been made superintendent of the Miami Valley Machine Tool Co., Dayton, Ohio.

K. Kishi, manager of the Osaka office of Andrews & George, Yokohama, Japan, spent October with the various American machinery and machine tool manufacturers for whom his firm is the Japanese sales agent.

Charles H. Jenness, for the past thirteen years with the Deane Steam Pump Co., Holyoke, Mass., has severed his connection with the company to accept the position of instructor of mechanical drawing in the Chicopee, Mass., high-school, made vacant by the resignation of Mr. George H. Babbitt, who resigned on account of ill-health.

William A. Tucker, superintendent and treasurer of the H. A. Rogers Co., New York, celebrated the thirtieth year of his connection with that company October 18. Mr. Tucker, who is known as one of the most experienced credit men in the machinery supply trade, is the oldest officer and employe of the company in years of service.

* * *

OBITUARIES

Franklin T. Zimmermann, vice-president and manager of the Zimmermann Mfg. Co., died at his home in Auburn, Ind., September 29, aged fifty-nine years.

George Poole, president of the Poole Engineering & Machine Co., Woodberry, Baltimore, Md., died at the home of his niece, Mrs. Robert R. Smith, in New Hartford, Conn., September 24, aged fifty-six years. Mr. Poole was identified with the concern of which he was president at his death for nearly forty years, having entered the shop with his father when seventeen years old. He learned the business thoroughly and was made superintendent and general manager while still a young man, the firm then being Poole & Hunt. When Mr. Hunt retired Mr. Poole was made vice-president and general manager of Robert Poole & Son, incorporated, and at the death of his father he became president and treasurer when the name of the company was changed to that now used. Many of the workmen still employed were with the company during the whole period of Mr. Poole's connection, and a few are descendants of men who worked for the father and helped establish the business. Mr. Poole leaves a widow, two daughters and a son, Robert Poole.

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COMING EVENTS

November 17-18.—Annual meeting of the Society of Naval Architects and Marine Engineers, 29 W. 39th St., New York. W. J. Baxter, secretary.

November 17-19.—Fourth annual convention of the National Society for the Promotion of Industrial Education, Boston, Mass. A feature of this convention will be a lecture on "Continuation Schools," by Dr. George Kerschensteiner, superintendent of schools, Munich, Germany. Edward H. Reisner, secretary, 20 West 44th St., New York.

December 5-6.—Annual meeting of the American Society of Refrigerating Engineers, New York. W. H. Ross, secretary, 154 Nassau St., New York.

December 6-9.—Annual meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York. Calvin W. Rice, secretary.

December 12-15.—Convention of the National Gas and Gasoline Engine Trades Association, Racine, Wis. Albert Stritmatter, secretary, Cincinnati, Ohio.

SOCIETIES AND COLLEGES

Drexel Institute, Philadelphia, Pa. Leaflet announcing evening courses in electrical, civil and mechanical engineering, and chemistry.

University of Tennessee, Knoxville, Tenn. Catalogue of the institution, containing photographic views, and description of the equipment, laboratories and courses.

NEW BOOKS AND PAMPHLETS

Annual Report of the State Geologist of New Jersey for the Year 1909. By Henry B. Kummel. 123 pages, 6 x 9 inches. One large folding map. Published by the State Geologist, Trenton, N. J.

Annual Report of the Chief of Bureau of Manufactures to the Secretary of Commerce and Labor, for the Fiscal Year ending June 30, 1910. 23 pages 6 x 9 inches. Published by the Department of Commerce and Labor, Washington, D. C.

Explosibility of Coal Dust. By George S. Rice, J. C. W. Frazer, Axel Larsen, Frank Haas and Carl Scholz. 186 pages, 6 x 9 inches. Illustrated. Published by the Bureau of Mines, United States Geological Survey, Washington, D. C., as Bulletin No. 425.

Ohio State University Commemorative Bulletin. By C. E. Sherman. 63 pages, 6 x 9 inches. Published by the University, Columbus, Ohio.

The bulletin gives the history of the institution and the educators connected therewith, maps, illustrations, description of engineering work, list of alumni and ex-students, and other information.

History of the Telephone. By Herbert N. Casson. 315 pages, 5 x 8 inches. Published by A. C. McClurg & Co., Chicago, Ill. Price $1.50.

This interesting book is written in the entertaining style characterizing the author's works, "The Romance of Steel," "Cyrus Hall McCormick, His Life and Work," "The Romance of the Reaper," etc. He is one of the few writers who are able to write interestingly and accurately of all phases of discovery and inventions and manufacture. The book is one that should form a very acceptable addition to the literature of the scientist, engineer and mechanic.

Applied Thermodynamics. By H. W. Spangler. 160 pages, 6 x 9 inches. Published by John Jos. McVey, Philadelphia, Pa.

This work by Prof. Spangler which contains the substance of his lectures to the students in the mechanical, electrical and chemical engineering classes of the University of Pennsylvania, treats of the flow of steam, steam engine tests, refrigeration (air machines—volatile liquids), absorption machines, internal combustion engines, and evaporators. The work was prepared for students and others having some preliminary knowledge of the subject, the author's "Notes on Thermodynamics" being an excellent introduction.

Wireless Telephones. By J. Erskine-Murray. 68 pages, 5 x 7 inches. 17 illustrations. Published by Norman W. Henley & Son, New York. Price $1.00.

The work is a popular description of wireless telephones and the principle of operation. It first describes the phenomenon of hearing and the conversion of sound into electric waves. The difference between wire and wireless transmission is simply explained and a diagram illustrates the radiation of electric waves from the conductor. Chapters V and VI are devoted to the production of alternating currents of high frequency, and how the electric waves are radiated and received. The receiving instruments and conductors are described in the following two chapters. The valuable feature of the book is the glossary of technical words used in wireless telegraphy and telephony.

The Indicator Handbook. By C. N. Pickworth. 142 pages, 5 x 7½ inches. 93 illustrations. Published by D. Van Nostrand Co., New York. Price $1.50.

This work which has passed into the fourth edition, has been completely reset in new type and new matter has been added. A chapter is devoted to indicator instruments designed for gas and oil engines, while optical indicators, pressure indicators, etc., also receive attention. The chapter headings are: Construction of the Indicator—Steam Engine Indicators; Indicators for Gas and Oil Engines, etc.; Errors of the Indicator; the Arrangement of the Indicator; Errors of the Indicator Connections; Indicator Reducing Gear; Errors of Indicator Reducing Gear; the Use and Care of the Indicator. The simplicity of treatment commends the book to stationary engineers, mechanics and others who may be required to prepare for indication and determining the results of tests.

Notes on Mechanical Drawing. By Horace R. Fry. 61 pages, 6 x 9 inches. Published by the University of Pennsylvania, Philadelphia, Pa. Price $1.00.

The number of books on mechanical drawing is legion and it is difficult for an author to present a treatise suitable to the needs of the average student that will differ in any fundamental respect from the many other books published before. We must say, however, that this work differs in certain practical respects from other works, to its own advantage. The book covers four courses in drawing for the freshman, sophomore, junior and senior years. The subject matter is: instruments; size of sheets, trimming; lettering; titles; scales; full, dotted, center, dimension, shade and construction lines; inking; dimensions; abbreviations; sections; cross-hatching; line shading; projections; bill of materials; assembly drawings; blueprints; sketching; gearing, screw threads; tapped holes; conventional threads; screw thread proportions and tables; tapers; weights of castings of forgings; pipe; etc. Tables of data of machine parts are provided as copy to give practice in lettering and tabular arrangement. These at the same time are valuable in themselves to the budding mechanical engineer or machine designer.

Machine Drawing. By Gardner C. Anthony. 104 pages, 6 x 7¼ inches. Published by D. C. Heath & Co., Boston, Mass. Price $1.50.

This well-known textbook on mechanical drawing has passed through several editions, and is in many respects deservedly one of the most popular works published for students. It is modern in its treatment and thoroughly practical from the mechanical engineer's standpoint, including, as it does, many examples of machine details which serve as excellent practice examples for the students and at the same time gives them knowledge of proper proportions of well-known machines and tools. The contents by the chapter headings are as follows: Screw Threads, Bolts and Screws, General Rules for Making Drawings, Sectional Views, Dimensioning, Technical Sketching, Examples for Practice, Tables. The examples for practice include: Bolt Drawing for Boiler Feed Pump, Assembly Drawing for Boiler Check Valve, Detail Drawing for a 2-inch Globe Valve, Assembly Drawing of a Connecting-rod, Assembly Drawing of a Crank Pin Stub End of a Connecting-rod, Detail and Assembly Drawing of a Cross-head, Assembly Drawing of a Slide Valve Engine Cylinder, Pillow Block Bearing, Screw Polishing Machine and Lathe Headstock and Detail Drawings of Lathe Tailstock, etc.

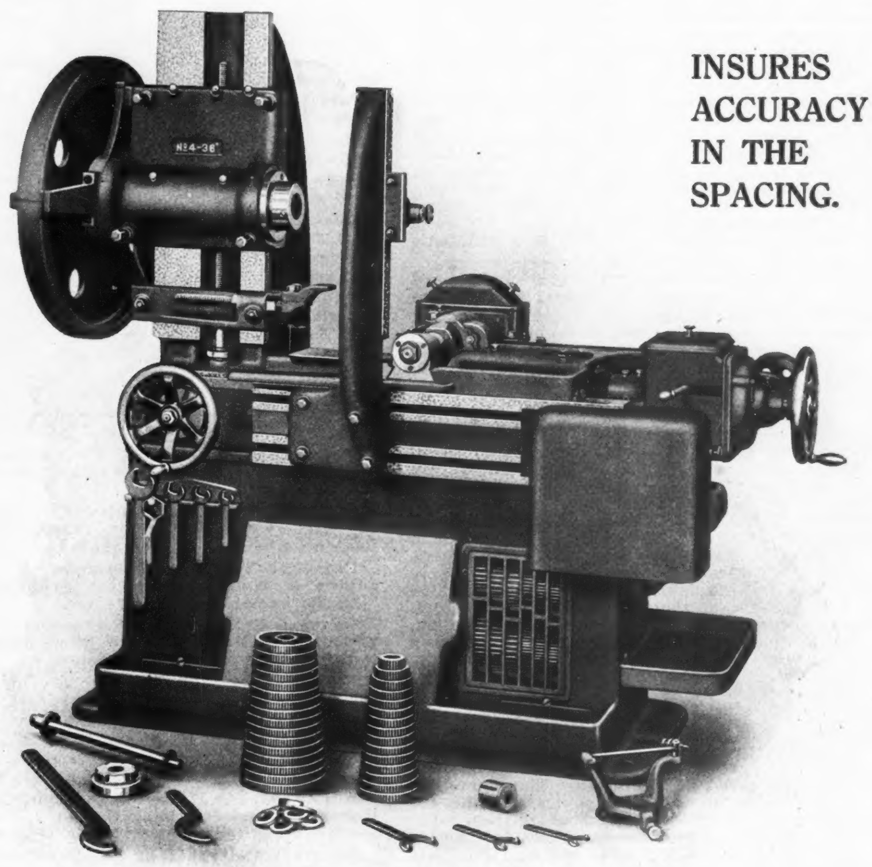
Workingmen's Insurance in Europe. By Lee K. Frankel and Miles M. Dawson, with the cooperation of Louis I. Dublin. 477 pages, 6 x 9 inches. Published by the Charities Publication Committee, 105 E. 22nd St., New York. Price $2.50; by mail $2.70.

The book deals historically with the introduction of workingmen's insurance and compensation in Europe. It is divided into four parts, *viz.*, Insurance against Accidents, Insurance against Sickness and Death, Insurance against Invalidity and Old Age, and Unemployment Insurance. A brief history is given of the development of employer's liability, and of changes in attitude of the public and the courts with regard to applying to cases of industrial accidents the old common law principles of assumption of risk and the fellow-servant rule. Various types of accident, death and burial associations are described, which antedated laws passed in Europe for insurance against loss or poverty due to these contingencies. The third part is devoted to insurance against invalidity and old age and its status in various countries is briefly mentioned. Insurance against unemployment is the subject of the fourth part, brief mention being made of the success or failure of this type of insurance in Germany, Norway, Sweden, Holland, Belgium, France, Switzerland, Italy, and other countries in which investigations were made.

Handbook for Heating and Ventilating Engineers. By James D. Hoffman, assisted by Benjamin F. Raber. 322 pages, 4½ x 6¾ inches. Published by James D. Hoffman, Purdue University, Lafayette, Ind. Price $3.50.

This comprehensive handbook on heating and ventilating work should be generally appreciated by architects, contractors, engineers and those who are required to design and install heating and ventilating work in offices, factories, mills and other buildings. It is of convenient pocket size, thus making it available for reference to the contractor or erector on the job. The work has been compiled for the most part from lectures given at Purdue University during the past eight years. Most of the material was previously issued in pamphlet form and used as a textbook with satisfactory results. Contents of chapters are as follows: Heat, Air, Heat Losses, Furnace Heating.

By means of the device for accelerating and retarding the movement of the indexing mechanism when starting and stopping the wheel, all unnecessary shock is eliminated.



INSURES ACCURACY IN THE SPACING.

B. & S. Automatic Gear Cutting Machines

In addition to the above feature we make special mention of the drive of the indexing mechanism, which is positive and driven independently at a constant speed, thus insuring rapid indexing irrespective of the speed or feed of cutter.

The mechanism controlling the locking disk can be adjusted so that the disk will make more than one turn, thus relieving the mechanism from heavy strains when indexing for small numbers of teeth.

Our General Catalogue, pages 138 to 149, shows a full line of these machines.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U. S. A.

Hot Water and Steam Heating, Mechanical Warm Air Heating, Mechanical Vacuum Heating, District Heating, Temperature Control, Electrical Heating, Specifications. A feature of the work that should be highly appreciated by engineers who collect all available data on heating and ventilation is the references to technical books and technical periodicals at the conclusions of the chapters. The authors realize the impossibility of compiling a complete digest in handbook form of available literature on the subject and have, therefore, referred readers to other sources of information. The book should be generally appreciated by those interested.

WORLD CORPORATION. By King C. Gillette. 240 pages, 6 x 9 inches. Illustrated. Published by the World Corporation, 6 Beacon St., Boston, Mass. Price $1.00.

This prospectus of the scheme of Mr. Gillette, the safety razor man, for unifying the world's industries no doubt contains a few grains of truth, but so buried in a mass of glittering generalities and obvious impracticalities as to make the common reader doubt the sanity of any part of the plan. Mr. Gillette seems to have a clear vision of the forces at work undermining representative government and dividing the population into two great classes—the rich and the poor—but in his endeavor to get away from destructive individualism he would create a structure so massive but weak that it must fall by its own weight. He would, for instance, concentrate the majority of the population of the United States into one gigantic city of 80,000,000, having its center in Buffalo, N. Y. The colossal egotism of the promoter is shown by the fact that he has planned and illustrated an enormous beehive tenement sheltering 10,000 which he proposes to make the standard type of housing for his "world corporation" city. We wonder if Mr. Gillette would take kindly to the idea of living in a house planned by an eighteenth century architect. So long as people think, invent, improve and progress it will be impossible for one generation to build for succeeding generations. It is an utter impossibility in a progressive age and when, if ever, it does become possible, it would mean that the period of crystallization, decay and death had been reached. The plan of "world corporation" apparently is a socialistic dream that out-Herods the rankest Herod of them all.

COMPOSITION AND HEAT TREATMENT OF STEEL. By E. F. Lake. 252 pages, 6 x 9 inches. 143 illustrations. Published by McGraw-Hill Book Co., New York. Price $2.50.

In this work the author, who is a well-known metallurgical expert, has simply described the process of making steel from the pig iron to the structural product and the tool steel bar. It has been prepared with a view of filling the want for a general book which treats of the principles and processes, and no attempt has been made to go into technical details. The author has endeavored to cover all materials that are used, either commercial or experimental, in making steel, but has not attempted to go into the metallurgical and chemical aspects of the different compositions. The chapter headings are as follows: Making of Pig Iron, Bessemer Process for Converting Iron into Steel, Open Hearth Process for Making Steel, Crucible Process of Steel Making, Electric Furnaces for Steel Making, Ingredients and Materials used in Steel, Working Steel into Shape, Furnaces and Fuels used for Heat Treatment, Annealing Steel, Hardening Steel, Tempering Steel, Carbonizing. The work is one that should be highly appreciated by the class who use and fabricate steel in the machine shop, but are more or less ignorant of the processes of manufacture. The chapters on furnaces and fuels used for heat treatment, annealing, hardening, tempering and carbonizing steel contain matter of practical application for the machinist, toolmaker and smith, and with the information contained in the previous chapters they will be provided with a work of much practical value.

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES. 1344 pages, 7½ x 10 inches. Published by S. E. Hendricks Co., 74 Lafayette St., New York. Price $10.00.

The nineteenth annual revised edition of this valuable trade directory just issued, is much improved and enlarged. The eighteenth edition required eighty-seven pages to index its contents, while the nineteenth edition required just one hundred pages or thirteen additional pages. As there are upwards of four hundred classifications on each page, the thirteen additional pages represent the manufacturers of over five thousand articles, none of which have appeared in any previous edition. The total number of classifications is 35,481, each representing some machine, tool, specialty or material required in the architectural, engineering, mechanical, electrical, railroad, mine and kindred industries. The eighteenth edition numbers 1220 pages, while the nineteenth edition numbers 1344 or 124 additional pages. Counting one hundred and fourteen pages of matter omitted from the new edition that appeared in the eighteenth edition makes a total of two hundred and thirty-eight pages of new matter, the whole representing upwards of 350,000 names and addresses. An important feature of the register is the simplicity of its classifications. They are so arranged that the book can be used for either purchasing or mailing purposes, all manufacturers of a particular trade being classified under a general heading for mailing purposes, and sub-divided under as many classifications as the variety of their products calls for. Among other valuable features are the inclusion of trade names of all articles classified, as far as they could be secured. These trade names appear in parentheses between the names and addresses under the classifications where they appear.

MECHANICAL ENGINEER'S POCKET BOOK. By William Kent. 1461 pages, 4¼ x 6¾ inches. Published by John Wiley & Sons, New York. Price $5.00, net.

This well-known reference book of rules, tables, data and formulas for the use of engineers, mechanics and students was first published in 1895, and soon became recognized as an authoritative compendium of mechanical engineering data. Its popularity is indicated by the fact that it has passed into the eighth edition and 71,000 have been printed. The eighth edition has been rewritten and reset throughout, the old electrotypes being so worn that new plates were imperatively required. Advantage of the fact was taken to use new and distinctive type for tables with heavier face than that of previous editions. The eighth edition is considerably enlarged, containing 340 pages more than the seventh, despite all efforts to condense the material into the smallest possible space. A greatly improved feature is the new index, which fills 45 pages, and contains 4500 titles, being nearly four times the size of the index in the first edition. Among the numerous alterations and additions are the following: The slide rule; logarithmic ruled paper; manufacturers' tables brought up-to-date; new Bethlehem structural steel shapes; new alloys for various purposes; chapters on cast-iron and malleable iron; matter on the new tool steels and other alloy steels; methods of preventing corrosion; small size spring table; new formulas for triple and quadruple riveted joints; tables of moisture and air at different pressures and temperatures; the fans, blowers, compressed air; heating and ventilation chapters rewritten; new steam tables based on tables of Marks and Davis; new matter on steam, boilers, chimneys, steam engines, locomotives, steam turbines, gas and oil engines, shafting, pulley, belting, gearing, hoisting and conveying, wire and rope transmission, friction and lubrication and the foundry. Machine shop data is given considerable space including matter on high-speed tool steels, Taylor's researches on cutting tools, emery wheels, force and shrinkage fits, etc. Kent's Pocket Book is popularly regarded as the mechanical engineer's Bible and the new edition should be even more favorably regarded than its predecessors. The only adverse criticism to be offered is in regard to the arrangement of the matter. We think the author could have advantageously followed the plan of arrangement found in *Des Ingenieurs Taschenbuch*, published by the Hutte Association, which appeals to us as being generally logical. Numerous cases of misplaced chapters can be found in Kent's, making reference tedious. All works of this sort should be arranged in such order that the constant user can readily find chapters on almost any subject without being obliged to turn to the index. The index is indispensable as it necessarily must be consulted for minor matters, but for the general subjects we believe that the arrangement of the book itself should be such as to enable even the occasional user to know just about where to look for a chapter on any subject. Otherwise the work has our hearty commendation.

CATALOGUES AND CIRCULARS

PEERLESS ELECTRIC Co., Warren, Pa. Folder advertising the Peerless motor.

CUTLER-HAMMER CLUTCH Co., Milwaukee, Wis. Circular of the Cutler-Hammer lifting magnet.

AMERICAN BLOWER Co., Detroit, Mich. Bulletin No. 284 descriptive of Sirocco fans and blowers.

NATIONAL TUBE Co., Pittsburg, Pa. Set of illustrated blotters advertising Shelby seamless tubes.

PIKE MFG. Co., Pike, N. H. Circular of the "Pyko" grinders for wood-working, machine, blacksmith, wheel-wright and other shops.

ADAMS-BAGNALL ELECTRIC Co., Cleveland, Ohio. Leaflet illustrating the regenerative arc lamp for lighting factories, foundries, mills, etc.

SAGINAW MFG. Co., Saginaw, Mich. Catalogue of the Gilbert wood split pulleys, printed in colors, illustrating the types and construction.

TRIUMPH ELECTRIC Co., Cincinnati, Ohio. Bulletin No. 391 descriptive of the direct-current, steel frame, type F "Triumph" motors.

ALLIS-CHALMERS Co., Milwaukee, Wis. Circular descriptive of the Allis-Chalmers friction clutch pulleys and friction clutch cut-off couplings.

FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind. Instruction book No. 3043 on type K single-phase integrating induction watt hour meters.

PENNSYLVANIA RAILROAD, Philadelphia, Pa. Pamphlet illustrating and describing the Pennsylvania Railroad standard steel underframe live-stock car.

ROCHESTER ELECTRIC MOTOR Co., Rochester, N. Y. Catalogue of the Rochester direct-current, constant-speed, variable-speed, and adjustable-speed motors.

CRESCENT TOOL Co., Jamestown, N. Y. Circular of the Crescent adjustable wrenches, Crescent combination pliers, linemen's pliers, "Simplex" combination pliers, etc.

GENERAL ELECTRIC Co., Schenectady, N. Y. Bulletin No. 4771 superseding Bulletin No. 4440 B on hand-operated starting compensators for alternating-current motors.

GENERAL ELECTRIC Co., Schenectady, N. Y. Bulletin No. 4774, superseding Bulletin No. 4564, on centrifugal air compressors for industrial air blast and exhauster service.

NORTH WESTERN EXPANDED METAL Co., Chicago, Ill. Pamphlet containing data for the use of designers using expanded metal for reinforcing concrete structures of all kinds.

ADAMS Co., 845 White St., Dubuque, Ia. Circulars Nos. 701 and 811 illustrating and describing the No. 1 Farwell quick change miller and the No. 3 Farwell automatic gear hobber, respectively.

MECHANICAL APPLIANCE Co., Milwaukee, Wis. Circular of the Watson buffers and grinders in bench or pedestal form, with either direct or polyphase alternating current, direct-connected motors.

CASTOLIN Co., 1609 Wright Bldg., St. Louis, Mo. Folder advertising "Castolin," a new process for brazing cast iron without the use of special appliances. Brazed castings are unaffected by water, acids or heat.

BARBER-COLMAN Co., Rockford, Ill. Circular descriptive of the No. 12 gear hobbing machine for cutting spur and spiral gears. It is a single-purpose manufacturing machine built expressly for heavy-duty work.

INTERNATIONAL TYPOGRAPHICAL UNION, 120-130 Sherman St., Chicago, Ill. Pamphlet of testimonials from students who have taken the I. T. U. course of instruction in printing, and have been greatly benefited thereby.

BAYONNE STEEL CASTINGS Co., Bayonne, N. J. Bird's-eye view illustration of Bayonne and surrounding territory showing advantageous location of Bayonne for prompt delivery of castings to a large manufacturing district.

STANDARD MFG. Co., Bridgeport, Conn. Circular illustrative of 4-inch, 6-inch and 8-inch automatic gear cutters, especially adapted for cutting spur gears, bevel gears, sprockets, small milling cutters, ratchets, knurls, etc.

BUFFALO STEAM PUMP Co., Buffalo, N. Y. Catalogue No. 229 descriptive of the Buffalo single, duplex and triplex power pumps for general water supply, boiler feed, mine pumping, paper mills, municipal water works, etc.

E. W. BLISS Co., 5 Adams St., Brooklyn, N. Y. Circular illustrating tools exhibited at the Brussels Exposition, comprising presses, tin can making tools, swaging machines, etc. The company received the Grand Prize for its exhibit.

BEMIS & CALL HARDWARE AND TOOL Co., Springfield, Mass. Catalogue and price list of wrenches No. 20, comprising drive punches, Briggs and Merrick nut wrenches, combination pipe and nut wrenches, adjustable S nut wrenches, etc.

HEALD MACHINE Co., 20 New Bond St., Worcester, Mass. Leaflet illustrating the Metcalf emery-wheel dresser, which consists of two heavy knobs on the end of a short shaft on which is mounted an abrasive wheel of special grade and grit.

CROCKER-WHEELER Co., Ampere, N. J. Bulletins Nos. 120, 122, 123 and 125 on belt-type, direct-current, generators, Form I, and belt-type direct-current generators, Form D, adjustable speed motors, and "Remek" type transformers for light and power.

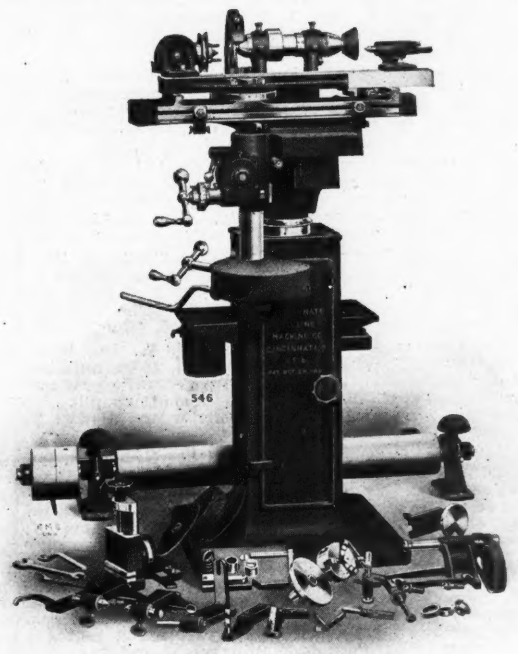
RAYMOND MFG. Co., LTD., Corry, Pa. Catalogue of wire springs and wire specialties, comprising extension springs, compression springs, springs of rectangular section, conical springs, agricultural implement springs, gas engine and automobile springs, bicycle saddle springs, etc.

The Cincinnati Cutter Grinders

YOU can't get efficient service from your Millers unless you keep the cutters properly sharpened. To do that you need the right kind of a grinder. Has yours graduated dials for all angular settings? Does it have a vertical adjustment independent of the swiveling movement? Has it a micrometer dial for determining the proper clearance angle, or must you measure the clearance with a scale? Does it hold end mills, face mills, etc., by their own shanks in the headstock spindle, or must you rest them in a V-block?

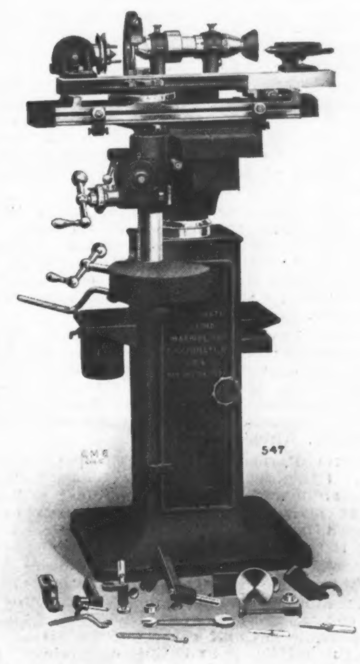
If it lacks a single one of these necessary features, you can't depend on its giving the results you want.

Send for our Grinder Catalog.



The No. 1 Complete Universal Cutter Grinder

We can supply it as a Complete Universal Tool Room Grinder for general use; cutter and reamer sharpening; surface, cylindrical and internal grinding.



The No. 1 Plain Cutter Grinder

We can supply it as a Plain Grinder for cutter and reamer sharpening. Attachments for the complete machine can be added as needed.

The Cincinnati Milling Machine Company

Cincinnati, Ohio, U. S. A.

EUROPEAN AGENTS—Alfred H. Schutte, Cologne, Brussels, Milan, Paris and Barcelona. Donauwerk Ernst Krause & Co., Vienna, Budapest and Prague. Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow.
CANADIAN AGENT—H. W. Petrie, Limited, Toronto, Montreal and Vancouver. AUSTRALIAN AGENTS—Thos. McPherson & Son, Melbourne.
JAPAN AGENTS—Andrews & George, Yokohama. CUBAN AGENT—Adolfo B. Horn, Havana.
ARGENTINE AGENTS—Adolfo Mantels & Co., Buenos Ayres.

WESTERN ELECTRIC Co., 463 West St., New York. Bulletin No. 9635 describing the Hawthorn commercial and folding type "mazdaliers," the new lighting fixture which has been developed since the advent of the mazda (tungsten) lamp in the field of commercial lighting.

AMERICAN LAMINATED BELTING Co., 113 Hudson St., New York. Booklet entitled "The Difference between Albeco Laminated and Multi-lap Leather Belting," giving comparisons of the operating principles, power transmitting qualities and ultimate economy of both types of belting.

BECKER MILLING MACHINE Co., Hyde Park, Mass. Pamphlet No. 56 descriptive of the new-model belted vertical-spindle Becker milling machine. Details of construction are shown, making the pamphlet of unusual interest to all interested in the design, construction and use of machine tools.

DICKERSON AUTOMATIC GOVERNOR Co., American Fork, Utah. Pamphlet descriptive of the Dickerson water wheel governor by Prof. E. H. Backstrand. This pamphlet will be found interesting to those concerned with the difficult problem of automatically governing the speeds of water wheels.

MECHANICAL APPLIANCE Co., Milwaukee, Wis. Bulletin No. R 1 illustrating and describing the Ajax electric riveting machines which punch the hole, drive and head the rivet with one pressure of the pedal, delivering blows at the rate of 6000 per minute. See MACHINERY, August, 1910, for descriptive note.

WEBSTER & PERKS TOOL Co., Springfield, Ohio. Catalogue of bolt-pointing, threading and special tapping machines, comprising single-spindle, two-spindle, four-spindle and six-spindle solid die automatic threading machines, single-spindle bolt pointing machine, duplex solid die automatic threading machine and accessories.

KEMPSMITH MFG. Co., Milwaukee, Wis. Bulletins Nos. 1, 2, 3 and 4 illustrating the growth of the new plant, construction of which was begun July 5. These interesting records of construction begin with the view of an open field, and close with views of the machine shop taken October 1, when the work was nearing completion.

JOSEPH T. RYERSON & SON, Chicago, Ill. Catalogue of emery wheel machinery, containing hints on selection of grade, mounting the wheels, and data for selection of grades, table of shapes and descriptions of bench, stand and cabinet base machines, water tool grinders, surface grinder, automatic planer knife grinder, buffing lathes and countershafts.

B. F. STURTEVANT Co., Hyde Park, Mass. Bulletin No. 182 on horizontal center crank engines, Class HC 1. The bulletin is gotten up in the attractive style characteristic of the Sturtevant bulletins in general, and shows views of the engine, constructive details and a direct-connected engine and Sturtevant high-pressure blower; also a direct-connected generating set, etc.

NATIONAL-ACME MFG. Co., Cleveland, Ohio. Folder illustrating the "Acme" automatic multiple-spindle screw machine for the manufacture of bolts, screws, nuts and all duplicate parts from metal bars, and containing list of railroad shops using "Acme" machines for producing locomotive parts. The illustration on the cover is a railroad train with a new design of locomotive, sure to interest superintendents of motive power.

PENNSYLVANIA RAILROAD Co., Philadelphia, Pa. Pamphlet by D. Ward King describing the King split log drag, a simple device for working country roads after heavy rains, putting them into condition to carry traffic without destructive rutting. The King drag has been used successfully in the West for years, and is really a marvelous device, considering its simplicity and the wonderful road improvement following its use.

PENNSYLVANIA STATE COLLEGE, Harrisburg, Pa. Bulletin No. 1 of Volume 1, outlining the purpose and work of the engineering experiment station and containing articles: "Results of Experiments on the Effects of the Form of Alternating Current Waves on the Life and Efficiency of Incandescent Lamps," by Prof. Charles Lambert Kinsloe, and "Practical Suggestions for the Construction of Concrete Floors," by Prof. Elton D. Walker.

PENNSYLVANIA RAILROAD SCHOOL OF TELEGRAPHY, Ridenour Bldg., Bedford, Pa. Pamphlet of the Pennsylvania Railroad School of Telegraphy where students are taught practical railroad work. An automatic sending machine with a transmitter that can be set at any speed has been installed. The regular railroad telegraph wires are run through the school and train orders are received and transmitted in the same way as in regular practice.

HENDEY MACHINE Co., Torrington, Conn. Catalogue of quick-threading attachment, describing a new threading attachment brought out by the company, by means of which a high-speed return of the carriage is possible without reversing the lathe. The catalogue is illustrated with halftones and line engravings, and a complete description of the construction and operation of the attachment is given. Directions for mounting the attachment in place on Hendey-Norton lathes are also included.

OSCAR E. PERRIGO, 6 Beacon St., Boston, Mass. Circular of Modern Systems Correspondence Schools, describing a new departure in correspondence school work, and advertising the introductory courses of instruction that have been lately established. These additional courses are intended for men who do not desire to spend the time and money required for complete courses, but who wish to acquire certain fundamental knowledge in various engineering subjects and modern manufacturing methods and systems.

NORTON CO. AND NORTON GRINDING Co., Worcester, Mass. Anniversary number of *Grits and Grinds*, a monthly bulletin published by the two companies. This anniversary edition for employes and friends is issued in commemoration of the twenty-fifth anniversary of the Norton Co. and the tenth anniversary of the Norton Grinding Co. It contains lists of the employes of both works and photographs of the officials, heads of departments and foremen, views of the offices and plants, and pictures of the officers of the Pike Mfg. Co., Pike, N. H., selling agents. This souvenir number is one of the handsomest typographical productions we have seen. It is of much present interest, and will acquire greater and greater historical value as the years pass.

TRADE NOTES

JONES & LAMSON MACHINE Co., Springfield, Vt., has begun the construction of a new shop, the concrete foundation for which is 100 x 520 feet.

FALLS RIVET & MACHINE Co., Kent, Ohio, maker of rivets, bolts, nuts and washers, has been purchased by Edwin Seedhouse and associates and will be conducted as heretofore.

FALLS CLUTCH & MACHINERY Co., Cuyahoga Falls, Ohio, formerly the power transmission and general machinery business of the Falls Rivet & Machine Co., has been purchased by Theophilus King and associates, and will be conducted as heretofore.

PITTSBURG TESTING LABORATORY, 325 Water St., Pittsburg, Pa., has moved its New York office from 1 Liberty St. to No. 50 Church St., Hudson Terminal Building. The New York office is in charge of Mr. William Zimmerman, the company's second vice-president.

BUFFALO STEAM PUMP Co., Buffalo, N. Y., has re-opened its St. Louis office, 911 Third National Bank Building. The office is in charge of H. H. Downes, who was transferred from the Buffalo office. Mr. Downes has had a wide experience in the lines handled.

SCREW CUTTING COMPANY OF AMERICA, 17th St. and Sedgley Ave., Philadelphia, Pa., manufacturer of power, lead and feed screws, is under new management. Mr. J. W. Bramwell has been elected general manager in place of Mr. E. W. Crellin, resigned. Mr. Bramwell also fills the office of vice-president.

WALTER MACLEOD & Co., Pearl St. and Produce Alley, Cincinnati, Ohio, has been awarded a contract by the J. Baum Safe Co., Cincinnati, Ohio, for a large plate heating furnace; also a complete furnace equipment for the Southern Motor Works, Nashville, Tenn., and W. H. Clore Mfg. Co., Washington, Ind.

BLACK & DECKER MFG. Co., 113-115 So. Calvert St., Baltimore, Md., is prepared to build special jigs, fixtures and tools for automobile, truck and airship parts, special engines, aeroplane engines, etc. The company has new equipment of high-class machine tools and small tools installed in a new building specially adapted to its purpose.

WESTINGHOUSE ELECTRIC & MFG. Co., Pittsburg, Pa., has received an order from the Simonds Mfg. Co. for six 500-KVA transformers and two 200 H. P. type HF rolling mill motors to be used in the new Lockport, N. Y., plant of the purchaser. The transformers will be used in stepping down the power purchased, from 12,000 to 480 volts.

VICTOR APPLIANCE Co., Watervliet, N. Y., has been incorporated under the laws of the state of New York, to manufacture automobile and motor boat specialties, and to do a general repair business. Their leading specialty will be a new flexible shaft coupling. The directors are Augustus Bigelman, Gustavus Garrow and Dewitt Tappan, all of Watervliet, N. Y. Capital $5000.

GOLDSCHMIDT THERMIT Co., 90 West St., New York, is now managed by Mr. William C. Cuntz, who succeeds Mr. E. Stutz, vice-president and general manager. Mr. Cuntz brings to his position a thorough knowledge of steel business and a wide acquaintance with railway and street railway officials of the country, having been connected for eighteen years with the Pennsylvania Steel Co.

TOLEDO-MASSILLON BRIDGE Co., Toledo, Ohio, reports that its crane business so far has been very satisfactory and the outlook for new business is bright. Owing to the volume of business secured, the company has found it necessary to increase its capacity, and has recently purchased a number of new tools and rented an additional machine shop. The plant is running night and day.

NORTHERN ENGINEERING WORKS, Detroit, Mich., crane builder, is completing an addition to its crane erecting shop. The new building is approximately 160 feet by 60 feet, of fireproof structural steel and brick construction, and steel window sash. Three cranes and two overhead trolley runs will serve the floor. Electric and pneumatic hoists will be used. The machinery was installed and the building made ready in October. A new storage yard for structural steel has been laid out alongside the addition and is covered by a 60-foot span, three-motor electric "Northern" gantry crane of special construction. The company reports the largest demand for its electric Northern cranes and other products in its history.

J. FILLMORE COX & Co., 26th St., Bayonne, N. J., manufacturer of pipe and tube bends and pipe coils of all kinds, special machinery, etc., is building a new plant at the foot of 37th St. and Ave. E, Bayonne, N. J., which will be equipped with modern machinery throughout. The company is in the market for power house equipment, office and factory heating systems, hangers, shafting, shop furniture, electric welding machinery, pipe threading and cutting machinery of all kinds, and pipe bending machinery, drafting-room equipment, cranes, conveyors, hoists, trucks, cars, etc. The company will be a large consumer of pipe tubing, fittings, and all appliances required in high-pressure work. Catalogues of manufacturers are requested.

FOOS GAS ENGINE Co., Springfield, Ohio, has received another order from the United States Government for the Foos vertical gas engines for the Ohio River improvement works. The success of two previous installations resulted in the third order which was for six engines, four of which are 100 horsepower three-cylinder vertical type, embodying a new feature of design. These engines will be operated by natural gas, but each unit will be so arranged that it can be quickly adapted for the use of gasoline or kerosene. These engines will be used for the operation locks which the government is building in the upper Ohio Valley to provide water to maintain trade navigation in the dry season. The locks are operated through the medium of compressed air and the gas engines will drive the air compressors.

STARK ROLLING MILL Co., Canton, Ohio, has developed a rust-resisting sheet metal product known as "Toncan" metal, which is being introduced for use where it is impracticable or impossible to paint black or galvanized sheet metal to preserve it. Its durability enables it to be used for irrigating flumes, culverts and other parts of water systems where unprotected metal would soon be destroyed. It is being used in the electrical field, for transformer, motor and oil switch cases, and for the construction of tubular telegraph and trolley poles. Another important use is for grain bins in grain elevators, where the carbonic acid formed by fermentation of the grain is very destructive of ordinary unprotected sheet metal. Obviously many other important uses have been found for this new non-corrosive sheet metal.

GISHOLT MACHINE Co., Madison, Wis., and Joseph T. Ryerson & Son, Chicago, Ill., announce an association of interests in the manufacture and sale of machine tools. Messrs. E. L. Ryerson and Clyde M. Carr of Joseph T. Ryerson & Son, have been made directors of the Gisholt Machine Co. New shops and buildings which will add greatly to the present capacity will be erected by the Gisholt Machine Co., and these, supplemented by the combined efforts of the sales organizations of the two companies, will greatly increase the capacity to serve the rapidly growing business. Joseph T. Ryerson & Son, by this announcement, signalize their entrance into the general machine tool field. This new line, with the machinery lines which they have heretofore been interested in, will be further strengthened by other new lines which will be added by the associated interests, as conservative business policy dictates.

SOCIETY OF AUTOMOBILE ENGINEERS, 1461 Broadway, New York, has now started work on standardizing the construction of automobiles. A division of its Standards Committee met in Cleveland in October to take up the matter of standardizing frames for the various sizes and types of automobiles now built. It is believed that a smaller number of sections would be sufficient, giving the following advantages: 1. Reduction of tool cost. 2. Increasing the output of presses by reducing change of tools. 3. Reducing the number of different sizes of stock required. 4. Reducing the number of variations in the size of all parts fastened to the frame. Besides the Frame

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Section Committee, there are fourteen other divisions of the Standards Committee as follows: Bearings, Broaches and Broached Holes; Carburetors; Constants for Certain Metals for Gears; Iron and Steel; Lock Washers; Nomenclature; Records of Gasoline Motor Characteristics; Seamless Steel Tubes; Springs; Shackle Bolts and Spring Fittings; Sheet Metal; Tire Efficiency; Wood Wheel Dimensions, and Fastenings for Solid Tires.